NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

**NALCOMIS/OMA:
FUNCTIONAL CONSIDERATIONS FOR AUTOMATING
ORGANIZATIONAL MAINTENANCE ACTIVITIES**

by

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March 1988

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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION	1b RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; Distribution is unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Naval Postgraduate school 6b. OFFICE SYMBOL (If applicable) Code 54	7a. NAME OF MONITORING ORGANIZATION Naval Postgraduate School
6c. ADDRESS (City, State, and ZIP Code) Monterey, California 93943-5000	7b. ADDRESS (City, State, and ZIP Code) Monterey, California 93943-5000
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)

NALCOMIS/OMA: FUNCTIONAL CONSIDERATIONS FOR AUTOMATING ORGANIZATIONAL MAINTENANCE ACTIVITIES

12. PERSONAL AUTHOR(S)

Allen, Ronald T.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Master's Thesis	FROM ____ TO ____	1988 March	168

16. SUPPLEMENTARY NOTATION

The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	MIS; Naval Aviation Logistics Command Management Information System (NALCOMIS); NALCOMIS for Organizational Maintenance Activities; Online computer system

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

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20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Prof. T.P. Moore	22b. TELEPHONE (Include Area Code) (408) 646-2642 22c. OFFICE SYMBOL Code 54Mr

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted. All other editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

U.S. Government Printing Office: 1986—606-24.

Approved for public release; distribution is unlimited.

NALCOMIS/OMA:
Functional Considerations for Automating Organizational Maintenance Activities

by

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Submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN INFORMATION SYSTEMS

from the

NAVAL POSTGRADUATE SCHOOL
March 1988

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ABSTRACT

This thesis shows that current plans for Naval Aviation Logistics Command Management Information System for Organizational Maintenance Activities (NALCOMIS/OMA) exclude several important data collection, processing, and reporting activities which currently take place at squadron maintenance activities. The importance of these local activities is demonstrated through interviews with NALCOMIS Phase II users and squadron maintenance managers. It is also shown that, although local in nature, these activities are vital to the achievement of the stated objectives of NALCOMIS.

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I. INTRODUCTION

A. BACKGROUND

The Naval Aviation Maintenance Program (NAMP), established by the Chief of Naval Operations in 1959, "provides an integrated system for performing aeronautical equipment maintenance and all related support functions." [Ref. 1:p. 1] It is based upon the concept that maintenance of Naval aircraft be performed at three different levels [Ref. 1:p. 3-1]:

1. Organizational (O-level),
2. Intermediate (I-level), and
3. Depot (D-level).

By assigning maintenance tasks to different levels according to complexity, better use of resources is possible. A routine daily repair or inspection, for example, is best accomplished by personnel assigned to the organization, or squadron in possession of the aircraft (O-level). Maintenance which is beyond the capabilities of the squadron, such as a repair requiring special equipment or training, is handled by the Aircraft Intermediate Maintenance Department (I-level). Even more complex repairs, such as major overhauls and rework, are performed at the Depot-level.

Due to a growing need for systems of "maintenance data collection, man-hour accounting, and aircraft accounting," the naval aviation Maintenance and Material Management (AV-3M) System was introduced as a part of the NAMP in 1965 [Ref. 1:p. 1]:

> The AV-3M System was developed to modernize the collection of data at the local level and to assist in the summary of information for reporting purposes. Limited capacity of both computers and communication equipment existed in support of AV-3M sites. Inefficiencies existed within AV-3M for data collection, data transfer to other systems, and timeliness of processing; however, the Navy was moving towards the establishment of a standardized system for coding logistics data and satisfying...reporting requirements. [Ref. 2:p. 3]

B. NALCOMIS

In order to alleviate the problems associated with the manual data collection and reporting methods of AV-3M, the Naval Aviation Logistics Command Management Information System (NALCOMIS) project was established in 1974. NALCOMIS was conceived as

> a modern computer system to provide timely and accurate aircraft maintenance, operations, and logistics data. These data are to be used in support of the day-to-day maintenance and supply activities, as well as to communicate key summary information [up the chain of command] for management analysis. [Ref. 3:p. 3]

"There are four primary objectives of NALCOMIS, each of which has a major impact on the mission capability and overall personnel effectiveness" at the Organizational and Intermediate Maintenance Activities

and the supply centers which support them [Ref. 2:p. 4]. These four objectives are:

1) Improved Aircraft Mission Capability.

2) Improved Aircraft Maintenance and Supply Support.

3) Improved Reporting to Satisfy Navy and Department of Defense Program Requirements.

4) Modernized Management Support.

It is estimated that NALCOMIS will require approximately three million lines of code and will consist of over twenty-eight hundred programs [Ref. 4]. Due to the size of NALCOMIS and the complexity of the functions it is to perform, development of NALCOMIS and release to the fleet is being accomplished in three phases [Ref. 5:p. 3-1].

Phase I serves as an interim system in support of Intermediate Maintenance Activities and Supply Support Centers until NALCOMIS development is completed. "Phase I provides the aviation maintenance and material managers with a long awaited automated repairables management tool." [Ref. 6] Also referred to as NALCOMIS Repairables Management Module (NRMM), Phase I has already been implemented at Naval Air Stations, Marine Aircraft Groups (MAGs), and Aircraft Intermediate Maintenance Departments (AIMDs) and Supply Support Centers (SSCs) aboard aircraft carriers.

Phase II provides automated data collection and online data processing capabilities to AIMDs and SSCs.

"Functional design was completed in September 1985 and software design and development commenced in August 1985." [Ref. 6] A prototype was installed at MAG-14, MCAS Cherry Point, in October 1986. Implementation of Phase II at selected AIMD/SSCs is currently in progress.

Phase III will automate Organizational Maintenance Activities (OMAs) much as Phase II is automating AIMDs. The initial design for Phase III, also called NALCOMIS/OMA, was completed in September 1986 and development was begun the following month. By July 1987, however, while NALCOMIS Phases I and II continued in various stages of implementation and testing, development of NALCOMIS/OMA was suspended due to end-of-fiscal-year budgetary constraints.

Also a part of Phase III, NALCOMIS for Detachments Subsystem (NDS) will provide smaller aviation detachments (e.g., LAMPS and VERTREP detachments) with management support and automation capabilities. NDS, currently in the early stages of design, will be a simplified version of NALCOMIS/OMA.

The Navy Management Systems Support Office, the designated central design activity for NALCOMIS, has expressed uncertainty as to the future of Phase III development. Should NALCOMIS/OMA, as currently defined, be further developed and tested, or should

NDS, a more streamlined version, become a basic building block and expanded as necessary to meet the requirements of larger maintenance activities? Or should some third alternative should be considered?

C. THESIS OBJECTIVES

The objective of this thesis is to show that current plans for NALCOMIS/OMA exclude several important data collection, processing, and reporting activities which currently take place at squadron maintenance activities. The importance of these local activities will be demonstrated through interviews with users of the NALCOMIS Phase II system and squadron maintenance managers. It will also be shown that, although local in nature, these activities are vital to the achievement of the stated objectives of NALCOMIS.

Several of the key development issues involved in automating the OMA will also be examined:

1) How can NALCOMIS provide management support to squadron maintenance managers?

2) What can NALCOMIS do at the squadron level to improve mission capability?

3) Should NALCOMIS/OMA be further developed or should NDS be expanded to meet the needs of the OMA?

D. SCOPE, LIMITATIONS, AND ASSUMPTIONS

While NALCOMIS has been divided into phases for development and implementation, each phase in itself represents a tremendously complex system. Therefore,

the intent of this thesis is not to provide detailed solutions to the technical issues which remain. It is, rather, an attempt to examine the big picture of NALCOMIS/OMA from both the computer systems management and organizational maintenance perspectives.

Due to time and travel constraints, research on organizational maintenance activities was conducted at one geographical site. Because NAMP procedures apply universally to Naval Aviation activities, it was not anticipated that this would be a limiting factor in the study. It was discovered, however, that while NALCOMIS is designed to support the NAMP, local procedures are also important. They are, in fact, vital to meeting the objectives of NALCOMIS. Therefore, conducting research at only one site did become a limiting factor in the study.

E. RESEARCH APPROACH

Numerous telephone conversations (commencing in July 1987) with the Commanding Officer and other Navy Management and Systems Support Office (NAVMASSO) personnel revealed that some uncertainties regarding NALCOMIS/OMA still existed. Since development of this particular phase of NALCOMIS was temporarily suspended due to fiscal constraints, it appeared to be a good time to examine some of these uncertainties.

After conducting an extensive search of publications dealing with NALCOMIS, it was determined that personal interviews would be required in order to establish:

1) Past and present management philosophies which led to the current plans for NALCOMIS/OMA,

2) The major concerns of those who had used Phase II and NALCOMIS/OMA prototype systems, and

3) Potential concerns of future users of the system.

The first objective was met through a visit with NAVMASSO personnel in Norfolk, Virginia. Interviews were conducted with key individuals who had been involved with Phase III during its earlier development. Additional information was obtained during a visit to former PMA-270 Maintenance Officer, CDR Bob Jaurnig.

Phase II users (and those with experience on a Phase III partial prototype at Arthur Andersen and Company), each having a great deal of experience as aviation maintenance managers, provided valuable insight into current and anticipated problems with the system. The author also gained some hands-on experience with the Phase II system.

Interviews were conducted at a typical organizational maintenance activity at Naval Air Station Lemoore, California, in December 1987, to further determine potential user concerns. These interviews were not intended to determine how future users would

react to using a computer system, but rather to document in detail some of the current procedures used in aviation maintenance. Because some procedures are local and therefore vary from one organization to the next, such a local study was felt necessary in order to determine what sort of flexibility NALCOMIS/OMA should possess.

F. ORGANIZATION OF THE THESIS

The organization of the remaining chapters of this thesis is as follows:

II. THE ORGANIZATIONAL MAINTENANCE ACTIVITY: Provides a brief overview of the Organizational Maintenance Activity and those individuals who will be using NALCOMIS/OMA.

III. NALCOMIS/OMA: Introduces NALCOMIS/OMA and NDS. It also includes a short discussion of some of the hardware and software constraints placed on the developers of NALCOMIS.

IV. DEVELOPMENT DECISIONS: Some of the critical decisions which must be made by those managing the development of NALCOMIS/OMA are discussed. Current plans for NALCOMIS/OMA are compared with the overall objectives of the project. Also, the implications of expanding NDS to meet the information needs of the OMA is examined.

V. USER CONCERNS: Contains the results of interviews conducted with maintenance managers who have gained experience with the NALCOMIS Phase II system and the partial prototype which exists at Arthur Andersen and Company.

VI. NAMP PROCEDURES: Introduces the VIDS/MAF--the tool used to collect most of the maintenance data in the squadron. The flow of the VIDS/MAF is traced through the maintenance organization and some of the potential benefits of automating the MAF are identified.

VII. LOCAL PROCEDURES: Several local management tools used by maintenance managers are identified. The importance of these tools is related to user's (bottom-level management's) acceptance of NALCOMIS/OMA.

VIII. ESTABLISHING AN EFFECTIVE INFORMATION SYSTEM FOR THE OMA: The attributes of an effective information system are applied to the results of the research contained in chapters IV through VII. By so doing, the importance of providing the OMA with local, pertinent, and flexible reporting capabilities is established.

IX. CONCLUSIONS AND RECOMMENDATIONS: Presents the conclusions of the study and makes recommendations for future actions and further research.

II. THE ORGANIZATIONAL MAINTENANCE ACTIVITY

While this thesis assumes that most readers have a fair knowledge of the organizational maintenance activity (OMA) and its functions, a brief overview should provide unfamiliar readers with some understanding as well. Although somewhat simplified, such an overview should also serve to identify those individuals at different levels in the organization that are referred to as maintenance managers in this thesis.

A. SQUADRON ORGANIZATION

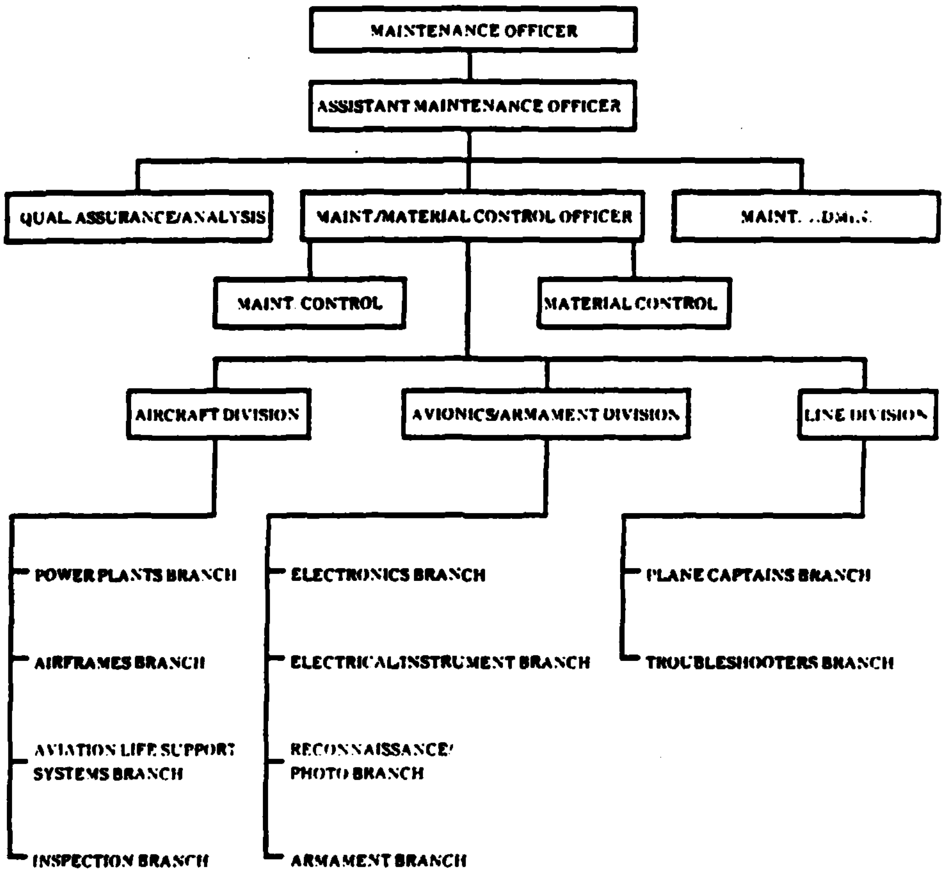
The naval aviation squadron is composed of four departments: Administrative, Operations, Safety, and Maintenance. Each of the departments is typically headed by an aviator who is a senior Lieutenant Commander or junior Commander. These officers periodically rotate from one department head billet to another in order to gain the experience necessary to later become a Commanding Officer. Therefore, the Maintenance Officer, for instance, is involved not only with the maintenance activities of the squadron but also with flying and other related duties as well. For this reason, he is surrounded by individuals who are devoted

primarily to maintenance--so called maintenance professionals.

The organization of the Maintenance Department is shown in Figure 1 [Ref. 7:p. 3-3]. As the lower portion of the chart indicates, the department is divided into divisions. Each division, in turn, is composed of branches. The Avionics/Armament Division, for example, consists of those branches which are concerned with the aircraft's electrical, electronic, and associated weapons systems. It is these branches which will commonly be referred to as work centers. Such a grouping of branches under common divisions has evolved in order to assure efficient organization of skilled personnel and proper assignment of maintenance tasks.

B. RESPONSIBILITIES

The Maintenance Officer (MO) is responsible to the Commanding Officer for all matters concerning the department. The Assistant Maintenance Officer (AMO), as the name implies, assists the MO in running the department. Usually an officer with no flying duties (ground officer) and designated a full-time maintenance manager, he has held various positions within the department in the past. Included among his responsibilities are administrative duties, liaison with other



Navy O-Level Maintenance Department Organization

Figure 1

departments, assignment of maintenance personnel, and training [Ref. 7:p. 4-7].

Quality Assurance/Analysis (QA/A), headed by the Quality Assurance Officer, is responsible for the overall quality of maintenance within the organization. Included among those programs assigned to QA/A are QA audits, Central Technical Publications Library, ground safety, and data trend analysis [Ref. 7:p. 5-11].

Several managers assist the QA Officer in his duties. The QA Chief Petty Officer (CPO), a senior enlisted individual with extensive knowledge of aircraft maintenance, is the QA Officer's right-hand man with respect to QA matters. Quality Assurance representatives, in addition to providing technical guidance in their particular areas of expertise, assist in the preparation of department maintenance instructions, certification of production (work center) personnel, and developing checklists for auditing work centers and specific maintenance programs [Ref. 7:p. 5-8]. The QA Analyst provides management with the data necessary to make decisions with regard to aircraft and equipment "condition, readiness, and utilization." [Ref. 7:p. 5-6] Finally, the Central Technical Publications Librarian maintains those publications pertinent to that particular maintenance activity.

Maintenance Administration provides clerical and administrative services for the department. Such services include maintaining reports and records for the department as well as preparing correspondence which requires executive action or special attention by the MO or higher authority [Ref. 7:p. 4-11].

Maintenance Control, as its name implies, is at the heart of the maintenance effort. Headed by the Maintenance/Material Control Officer, it is the central point of coordination between work centers. By keeping the overall picture of aircraft maintenance in mind, decisions are made about the priority of each job and which resources to apply to those jobs. A Maintenance CPO, stationed at the Maintenance Control desk during each work shift, is the individual primarily charged with making those decisions.

Material Control consists of aviation storekeepers who act as points of contact between department personnel and the supply activity that supports the squadron. Trained in supply requisition procedures, they order parts and materials in support of the maintenance effort and provide department managers with the status of those requisitions. Material Control also maintains the squadron's Operating Target (OPTAR) account which consists of those funds from which the

squadron buys aviation fuels, flight clothing and other administrative supplies.

The Individual Material Readiness List (IMRL) is also managed by Material Control personnel. The IMRL manager maintains transfer, receipt, and custody records of those support equipment items which are in the squadron's possession.

Each division is headed by a Division Officer and a Division CPO. Depending on the number of officers and CPOs available in the squadron, some branches may also contain a Branch Officer and/or CPO.

Management of the hour-by-hour tasks assigned to each work center is done by the work center supervisor. His importance cannot be overemphasized:

> If successful accomplishment of assigned tasks could be attributed to any one group of personnel, it would be the work center supervisors. Diligent supervision at the work center level includes rigidly adhering to...procedures and policies. To ensure the accomplishment of all assigned work, maximum efficiency must be obtained and maintained in the use of manpower, material, and facilities. [Ref. 7:p. 9-1]

C. EXCHANGE OF INFORMATION

While Figure 1 [Ref. 7:p. 3-3] shows the hierarchical composition of the Maintenance Department, it does not show the constant exchange of information that takes place between the various components making up the department. Because aviation maintenance is a dynamic activity filled with uncertainty, timely

communication among those various components is the key to smooth and efficient operations. As will be shown later, such communication currently occurs in the OMA and must occur in any future system if it is to prove useful to maintenance managers.

In addition to information exchanges within the Maintenance Department itself, there also exist exchanges between Maintenance and other departments as well. Most pertinent to this thesis are the exchanges which take place between the Maintenance and Operations Departments. Operations, in its planning and scheduling of flights, must be aware of the maintenance situation. It must, for instance, know how many aircraft are available to fly and what, if any, aircraft subsystem limitations exist.

Maintenance must likewise be aware of the needs and requirements of operations. It must know not only how many aircraft are needed, but also what sort of aircraft subsystems are required to fulfill the mission, how much fuel is required, what weapons are needed, etc. Because the maintenance situation is always changing, both departments must remain in constant communication with one another.

The OMA also depends on communication with other organizations. Maintenance personnel must be able to find out when they can expect replacement parts which

have been ordered from the Supply Support Center (SSC). Also, the OMA must be able to communicate with the local Aircraft Intermediate Maintenance Department (AIMD) so that it knows the status of aircraft components which are being repaired at the AIMD.

The exchanges of maintenance and supply information within the aviation squadron, and among the squadron and the AIMD/SSC, should be improved by NALCOMIS/OMA. Communication among the activities involved in aviation maintenance should become faster and more efficient through the use of automated data collection and processing. NALCOMIS/OMA and its functions will be discussed in the following chapter.

III. NALCOMIS/OMA

A. GENERAL SYSTEM DESCRIPTION

NALCOMIS/OMA is seen as a means of achieving improved mission capability at the squadron level. In achieving this end, it is proposed by the Navy Management Systems Support Office that NALCOMIS will [Ref. 3:p. 4]:

1) Support "a thorough inspection and approval process...to verify repair completion and determine material readiness."

2) Assist in "establishing a maintenance schedule by considering the priorities of available resources including skills, worker hours, material, and support equipment."

3) Provide an information reporting capability.

4) Provide for the "tracking and controlling of resources."

5) Reduce administrative burden within the OMA.

NALCOMIS/OMA is to provide such capabilities to activities both afloat and ashore.

The primary objectives of NALCOMIS are described in the system's Functional Description [Ref. 3:p. 3]:

1) <u>Improved Aircraft Mission Capability.</u> Through more accurate and timely processing of data, the organizational levels will be able to better manage and take action on the information provided by the system. Delays due to awaiting maintenance (AWM) or awaiting parts (AWP) will be reduced. This will in turn greatly improve the aircraft availability and overall maintenance capability.

2) <u>Improved Aircraft Maintenance and Supply Support.</u> Through more accurate and timely information, maintenance and supply personnel will be able to improve their overall productivity and available man-hours. The component turnaround time will be reduced as a result of faster supply response time and less time spent on ADP oriented activities. NALCOMIS has been designed to follow NAMP guidelines for both supply and maintenance functions.

3) <u>Improved Reporting to Satisfy Navy and Department of Defense (DOD) Program Requirements.</u> The entire NALCOMIS system will provide interfaces which are straightforward and automated, requiring little manual intervention. Data sent [to]...AV-3M and other naval aviation logistics support systems are maintained within NALCOMIS to provide timely, accurate, and complete data in the format acceptable by each system. The OMA system will provide interfaces to AV-3M.

4) <u>Modernized Management Support.</u> The system will provide comprehensive support of aviation maintenance and supply functions at the organizational and intermediate levels, both ashore and afloat. The on-line, interactive features of NALCOMIS will provide the needed response time to support daily activities and provide timely information to local managers and [other information] systems. Common inputs and outputs also have been designed throughout the system to facilitate training activities and ease of use. A common data base will ensure data control and overall accuracy and validity of information.

"Standardization of Automated Data Processing (ADP) hardware and system software was achieved under the Shipboard Non-tactical ADP Program (SNAP) I, Phase 2." [Ref. 2:p. 3] The SNAP I minicomputer hardware targeted for NALCOMIS/OMA consists of [Ref. 3:p. 21]:

1) The central processing unit...a HIS [Honeywell Information Systems] DPS 6/74 processor with one megaword (MW) of memory.

2) Storage media for the nondeployable configuration...four 67 megabyte (MB) disk drives (268 MB of total disk storage). The deployable

storage media...six 50.1 MB Winchester disk drives (300.6 MB total disk storage).

3) Up to two 300 lines per minute (LPM) printers and up to three ASPI-34 form printers.

4) One console terminal, fifteen work station terminals, sixteen 80 characters per second (CPS) screen printers (one attached to each terminal) and two eight-inch diskette handlers.

A similar hardware environment exists at the IMA/SSC (NALCOMIS Phase II) level.

NALCOMIS/OMA is being designed such that it will provide on-line, real time capabilities 22 hours per day with the remaining two hours reserved for batch and backup processing:

> On-line functions are performed by user personnel operating keyboard video display terminals (KVDTs) located in their assigned sections or work centers. On-line functions allow the immediate entry, update, or retrieval of information. These on-line functions are controlled by an on-line monitor. Batch processing functions, which are not controlled by an on-line monitor, are either queued for immediate processing or are performed at scheduled periods each day depending upon the level of system resources required to complete the batch processing function. Hardcopy notices, reports, report extracts, data base purge processing, and data base reorganizations are examples of batch processing functions [Ref. 8:p. 5].

As developed thus far, NALCOMIS for OMAs is divided into 10 subsystems [Ref. 3:pp. 8-10]:

1) Data Base Maintenance Subsystem. This subsystem establishes and maintains the nonvolatile data within NALCOMIS and performs the necessary local data base support functions for all subsystems.

2) Flight Activity Subsystem. The major functions associated with this subsystem include the recording of aircraft flight utilization data on the Naval Aircraft Flight Record...(i.e., the "Yellow Sheet").

3) Maintenance Activity Subsystem. This subsystem includes those functions and processes required to maintain aircraft, engines, and equipment. [It also] provides the capability to perform fully automated processing of the Visual Information Display System/Maintenance Action Form (VIDS/MAF) in accordance with policies described in the NAMP.

4) Configuration Status Accounting Subsystem. This subsystem provides the capability to establish and maintain the configuration profile of aircraft, aircraft engines, aircraft components, engine modules and components, support equipment, and support equipment components.

5) Personnel Management Subsystem. This subsystem includes the functions necessary to collect and maintain specific personnel data for both military and civilian personnel assigned to an organization.

6) Asset Management Subsystem. This subsystem addresses the management of aircraft and equipment assigned to an organization. All aircraft and specific equipment are inventoried and the readiness status determined and recorded.

7) Local/Upline Reporting Subsystem. This subsystem provides the capability to capture information accumulated by the other subsystems, combines and consolidates that data into detail and summary level management reports, and extracts the data base information necessary to satisfy the...reporting requirements of the NAMP.

8) System Support Subsystem. Communication between organizations is also handled by this subsystem through the maintenance of on-line messages to the appropriate organization.

9) Data Offload/Onload Subsystem. This subsystem provides for the offload/onload of data associated with the transfer/arrival of aircraft, equipment and personnel.

10) Technical Publications Subsystem. This subsystem tracks the location of technical publications owned by the organization and provides on-line access to that information.

Each of the subsystems in NALCOMIS/OMA consists of on-line screens and conversations. "An on-line screen is a formatted display of input forms or output data. An on-line conversation is the collection of screens required to accomplish a single business function." [Ref. 8:p. 3]

Each subsystem offers several other output products to the user. Electronic messages may be sent from one terminal to another. Printed output, in the form of notices and reports, is also available. "A notice is a document printed as a result of an on-line transaction that requires immediate follow-up action. A report is a multi-page document containing information for local and [higher level] management." [Ref. 8:p. 3].

Each of the conversations within NALCOMIS follows one of five conversation categories [Ref. 3:p. 14]:

> 1) <u>Data Entry.</u> This conversation is used to enter data on either a single screen or a series of screens. Depending on the conversation, a mailbox message, hardcopy notices, or interface record may be generated. Examples of data entry conversations are the creation of MAFs, personnel records, and aircraft records within NALCOMIS.
>
> 2) <u>Update/Delete.</u> This conversation [is used]...to select the desired record for processing. Depending on the conversation, a mailbox message, hardcopy notice, or interface may be generated. Examples of an update/delete conversation are to update a MAF job status or to delete a component configuration record.
>
> 3) <u>Display.</u> This conversation displays a single record...No mailbox messages, hardcopy notices, or interfaces are generated. Example conversations are to display a specifically identified MAF, material requirement, or personnel record.

4) List Display. This conversation displays a list of specific records...No mailbox messages, hardcopy notices, or interfaces are generated. Example conversations are to display information for all open MAFs for a work center, list all personnel with a specific SMQ [Special Maintenance Qualification], or list all material requirements for a MAF.

5) Batch Report Request. This conversation requires entry of the report identification and data selection criteria, if required. The report is then produced during a subsequent process. The report request will be used to notify the system operator to produce the proper report. In addition to requested reports, the system will automatically produce standard batch reports routinely printed on a daily, weekly, monthly, and quarterly basis.

Qualified users will be allowed access to the system during sign-on via unique passwords. Access to specific conversations will be limited to those individuals possessing an appropriate Special Maintenance Qualification code. Classified data will not be processed by NALCOMIS/OMA.

Various failure contingencies are required for NALCOMIS/OMA. Squadrons must be provided with alternative methods for data collection and processing in case the system unexpectedly goes down. Such alternatives might include processing on another computer system or even reverting to manual methods (paper MAFs). Although a detailed analysis of contingency procedures is beyond the scope of this thesis, some discussion is included.

NALCOMIS/OMA will be required to communicate with other systems. One such interface will allow the AV-3M

system to "process summary information to analyze the performance of NALCOMIS/OMA organizations." [Ref. 8:p. 27] In addition, similar data reporting to Aircraft Controlling Custodians and Type Commanders will be supported. Other NALCOMIS sites, such as IMAs and Supply Support Centers will also be capable of interfacing with the OMA.

The NALCOMIS program manager is Naval Air Systems Command Headquarters (Project Manager Air-270) and the Central Design Agency is the Navy Management Systems Support Office (NAVMASSO) [Ref. 1:p. 8-3]. NAVMASSO is responsible for design, development, implementation, and life cycle support for NALCOMIS. The NALCOMIS/OMA contractor is Arthur Andersen and Company.

B. NALCOMIS FOR DETACHMENTS SUBSYSTEM--NDS

For aviation detachments serving aboard ships which are not supported by IMA/SSCs (i.e., LAMPS and VERTREP detachments), a slightly different automation approach is necessary. This MIS has been termed NALCOMIS for Detachments Subsystem (NDS). The major difference between NALCOMIS/OMA and NDS lies in the direct communication link with the facility which processes data (the Data Services Facility) for the AV-3M system. NALCOMIS/OMA will have that capability while NDS will not. Maintenance data collection and processing

requirements within the detachment, however, remain much the same as those within the squadron.

The SNAP I contract dictates the hardware to be used for NDS. The hardware tentatively selected for NDS includes [Ref. 9:p. 27]:

> 1) The Central Processing Unit [to be] a Honeywell Personal Computer Advanced Processor with 4 MB of memory and DPS 6/54 emulation board.
>
> 2) Storage media...one 80 MB fixed disk drive.
>
> 3) The output devices...one 132 column 150 CPS matrix printer and a high resolution monochrome monitor (color monitor with RGB may be used).
>
> 4) Input/Output devices...one 1.2 MB diskette drive.

Design and development of NALCOMIS/OMA is ahead of NDS. Initial design for NALCOMIS/OMA had been completed and development had begun when funding became unavailable in July 1987. Design work on NDS, however, was just beginning.

It is proposed by NAVMASSO that NDS remain as much like NALCOMIS/OMA as possible since there are many functional similarities between the two systems [Ref. 10]. Nevertheless, improvements in design from NALCOMIS/OMA, such as screen design, are to be incorporated in NDS where practical [Ref. 11].

NDS is to contain only those essential functions required for detachment personnel to effectively manage their maintenance business. Ideally it might be

thought of as a subset of the overall NALCOMIS/OMA incorporated on a microcomputer.

The NDS concept is based on the same 10 subsystems as NALCOMIS/OMA, with only streamlined functions performed by each subsystem. Exactly which functions are to be a part of NDS is yet to be determined.

C. HARDWARE COST

Perhaps the most important question regarding the future of automation at the OMA concerns the direction to be taken when funding is once again available for NALCOMIS/OMA. The cost of the minicomputer hardware specified by the SNAP contract is estimated at $200,000 per squadron [Ref. 12]. Coupled with the fact that there are approximately 400 O-level squadron maintenance activities, hardware delivery costs alone approach $80 million. Due to these and other expected long term maintenance costs [Ref. 13], there has been discussion at the Program Manager and Central Design Activity levels to proceed in one of two ways:

1) Have sister squadrons share hardware. In other words, rather than placing one minicomputer in each parent squadron, each minicomputer should be shared by two (or more) squadrons, or

2) Abandon the NALCOMIS/OMA approach and replace it with NDS. NDS would, in effect, become Phase III.

Sharing minicomputer hardware among squadrons, if such an option were to prove technically feasible, would certainly cut the costs of hardware considerably.

Of primary concern, however, is the fact that when a minicomputer goes down, more than one squadron will have to shift into a contingency mode of operations. No one is absolutely sure just what the effects of a system failure will be on a squadron, but it will present an undesirable situation.

D. HARDWARE AND SOFTWARE CONSTRAINTS

In attempting to discover just how current NALCOMIS/OMA plans evolved, the author was concerned primarily with two questions. First of all, why is NALCOMIS/OMA being developed on a minicomputer? Secondly, why must COBOL be used? These questions were asked in order to gain a sense of understanding for how NALCOMIS/OMA had come to exist as it currently does.

NALCOMIS/OMA, in its current form, did not emerge as the result of one individual's ideas about information systems design. Rather, it is the result of the thoughts of many individuals and groups over an extended period of time. It also appears that certain political, as well as design, philosophies have contributed to the shaping of present plans for NALCOMIS/OMA.

1. Standardization

Most simply stated, the hardware and software constraints placed on NALCOMIS/OMA developers are the result of attempts at standardization. The SNAP

contract, under which NALCOMIS falls, "aims to standardize and integrate the Navy's non-tactical hardware and software." [Ref. 14:p. 91]

a. Hardware

Consider the minicomputer environment which is planned for NALCOMIS/OMA. That particular hardware was selected as a result of the SNAP contract with Honeywell. The contract is a binding agreement by which those involved in the design and development of NALCOMIS/OMA must live. Contrary to the customary information systems design and development process, however, the hardware was selected before the requirements were fully known:

> During a system design project, hardware requirements are typically forecasted only after the functional design of the system has been completed. During the NALCOMIS development, a preliminary design as well as a fixed hardware environment were provided as constraints [Ref. 3:p. 25].

Although there are definite advantages to standardization in a general sense, determining what sort of hardware is to be used before requirements for a system are determined places many constraints on those developing the system and usually makes those acting as intermediaries between the developer and user (e.g., NAVMASSO) experience many frustrations as well. Those frustrations may be the result of trying to design an application which will fit the hardware.

As currently planned, implementing NALCOMIS using remote work station terminals means that automation will be limited to access of a central data base. No stand-alone capabilities will exist within the work center itself. Placing SNAP I hardware at the squadron level also imposes certain other limitations:

1) The number of possible contingency plans which can be considered is reduced. When the minicomputer is down, NALCOMIS for OMA is down.

2) Sharing of peripheral devices between work stations is not possible. When the number of peripheral devices (such as printers) required for one OMA is multiplied by the total number of OMAs to be served by the system, this limitation can greatly increase the total cost of hardware.

Less expensive hardware alternatives could prove equally suitable. For instance, perhaps some microcomputer network would serve the same (or maybe greater) purpose than a more costly minicomputer.

Strategic planning for a system such as NALCOMIS isn't easy, however. Long lead times are required to ensure that the necessary hardware is available when needed. Another important factor is the long lead time required for ship alterations [Ref. 15]. Hardware cannot merely be carried on board ship ready to go. The ship must be modified (holes cut in bulkheads where necessary, spaces readied, etc.) in order to accommodate the hardware. Not only does this require much time to plan, but it also incurs major expenses.

Therefore, the hardware constraint placed on NALCOMIS was a result of the best information available at the time such decisions were made. Since 1982, when the SNAP contract was drawn up, technology has changed tremendously. That rapidly changing technology continues today. This makes strategic planning for MIS extremely difficult. Since we can only speculate what technology will exist in the future, the only reasonable course of action in selecting hardware is to choose the best, proven technology in existence at the time of our planning.

b. Software

The selection of COBOL as the programming language to be used in NALCOMIS/OMA also comes from a desire to achieve standardization. COBOL has become the standard throughout much of the business world:

> The widespread acceptance of COBOL stems from the ready availability of COBOL-trained programmers, and the considerable body of existing application programs already written in that language...Organizations using COBOL as their sole language are not 'locked' into a particular manufacturer's hardware, since virtually all commercial machines have available excellent COBOL compilers. [Ref. 16:p. 348]

When considered in conjunction with the hardware environment selected, COBOL doesn't appear to be too much of a constraint. Because a minicomputer and, as a result, NALCOMIS/OMA, lends itself to a MIS which performs transaction processing, COBOL is perhaps as well suited as any other language.

If NALCOMIS/OMA were being developed to allow limited or extensive stand-alone computing capabilities, then we might become concerned about the selection of COBOL. Some commercially available applications packages might provide useful capabilities to maintenance managers. Lotus 123 and other software packages are already being used to produce management reports within aviation squadrons (see chapter VII).

Most of the currently available packages are not written in COBOL, however, and cannot be used in NALCOMIS--because COBOL is the standard [Ref. 15]. When a suitable application program, but one written in a language other than COBOL, already exists commercially, it is not even considered for use in NALCOMIS. One software developer, interviewed for this thesis (but wishing to remain anonymous), stated that he would not hesitate using a commercially available software package if that were allowed. By finding a suitable package already in existence one would be taking full advantage of available resources--and saving money on unnecessary development costs.

2. Control Over Squadron Data

One further point concerning the minicomputer hardware targeted for NALCOMIS/OMA is worth consideration. Selection of a minicomputer with a central data base allows Aircraft Controlling Custodians and Type

Commanders greater control over a squadron's data. While perhaps not apparent at first glance, this is a monumental change in the way things have been done in the past.

Greater control over a squadron's data theoretically means that those receiving reports can be assured that the organization is reporting factual data. In effect, a squadron loses control over what it reports. For example, when reporting the status of aircraft (i.e., Mission Capability), the squadron presently prepares the reports manually. With NALCOMIS, however, squadron managers can no longer manipulate the data to be reported.

It might appear initially that the only motivation a squadron has for manipulating data is to improve performance statistics--making the squadron look better on paper. This, however, is not necessarily the case.

The purpose of a status report, as its name implies, is to provide upper management with a summary of a squadron's status (how many aircraft are available, how many are flyable, etc.). The usefulness of such a report to upper management might depend somewhat on the report being reviewed by the squadron before it is sent out.

One squadron Maintenance/Material Control Officer (MMCO) stated that, when manually reporting the status of his assigned aircraft, he uses his judgement and experience to determine which aircraft are up and which are down. If he has the resources (e.g., parts and workers) available to repair an aircraft in a short period of time, then he will report the aircraft up. Why report an aircraft down if it will be repaired within a half-hour or so?

If data is reported automatically by NALCOMIS/OMA, then we must wonder if it is painting an accurate picture of the squadron's readiness posture. The data would certainly be accurate at the moment that it was reported, but without applying judgement and expertise of the squadron manager, it might become very quickly outdated.

This issue, while political in nature, must be considered in order to fully understand its implications. If Aircraft Controlling Custodians and Type Commanders want a more accurate picture of fleet performance, then will this gain of control over squadron data provide a step in that direction? There are several other things to keep in mind. This type of automatic reporting system could result in:

1) Performance statistics dropping dramatically and, as a result, fleetwide revision of performance goals, and/or

2) Squadron maintenance managers learning how to work around the system and improve their performance statistics.

While it is difficult to be sure what the full effects of higher authority gaining greater control over squadron data will be, it is possible that not all of the effects will be desirable.

3. Project Pressures

While plans for NALCOMIS/OMA have undergone much reexamination already, some of those plans are still under scrutiny. Changing plans costs time and money. Therefore, each time an issue such as hardware selection is readdressed, there may be a cost involved. As a result, there is a hesitancy by those managing the project to make any changes in plans.

The feeling among those bearing the pressures of managing the development of NALCOMIS/OMA is that the project must be continued as currently planned. A large amount of money has already been spent on the current plans for NALCOMIS/OMA and it is, therefore, too costly to make any major changes [Ref. 15]--an understandable feeling given such a burden of responsibility.

IV. DEVELOPMENT DECISIONS

The purpose of this chapter is to point out some of the issues which face those managing the development of NALCOMIS/OMA. Among the questions which they must face are:

1) How can NALCOMIS provide management support to squadron maintenance managers?

2) What can NALCOMIS do at the squadron level to improve mission capability?

3) Should NALCOMIS/OMA be further developed or should NDS be expanded to meet the needs of the OMA?

The first two questions deal with the objectives of NALCOMIS--particularly, providing "modernized management support" and improving "mission capability." [Ref. 3:pp. 3-4] In discussing these questions, we will attempt to identify those activities in the OMA which must be positively affected by NALCOMIS/OMA in order to benefit from computer technology.

Brookes [Ref. 16:p. 98] points out that, when defining user requirements, it is "more difficult but more potentially rewarding [to identify] the opportunities for a new system to make a major impact on a key area associated with the success of the business." Since the OMA is in business to provide mission capable aircraft, NALCOMIS/OMA should provide its greatest beneficial impact in that area.

The third question deals with the direction which plans for NALCOMIS Phase III will be taking in the near future. The question of whether or not NDS should be expanded to meet the needs of all squadrons, and not just smaller detachments, will be presented by contrasting the grand-design and piece-at-a-time design approaches [Ref. 17:p. 26].

A. NALCOMIS AS "MODERNIZED MANAGEMENT SUPPORT"

This section will attempt to provide insight into how NALCOMIS can (and should) provide support to squadron maintenance managers. The value of NALCOMIS/OMA to managers will be discussed by distinguishing between management information systems (MIS) and transaction processing systems. Decision making in the OMA will also be examined in order to determine those key areas which could best be served by NALCOMIS/OMA.

1. MIS versus Transaction Processing

> A data processing system processes transactions and produces reports. It represents the automation of fundamental, routine processing to support operations...A management information system is more comprehensive; it encompasses processing in support of a wider range of organizational functions and management processes...Therefore, the significant issue is the extent to which an information system adopts the MIS orientation and supports the management functions of an organization. [Ref. 18:pp. 10-11]

Is NALCOMIS for OMA as currently planned a true management information system or is its purpose solely

that of transaction processing? It might be quite useful to examine this issue while keeping in mind what services NALCOMIS should provide to the OMA in the future.

Once again, the stated objectives of NALCOMIS are [Ref. 3:p. 3]:

1) Improved Aircraft Mission Capability.

2) Improved Aircraft Maintenance and Supply Support.

3) Improved Reporting to Satisfy Navy and Department of Defense Program Requirements.

4) Modernized Management Support.

In understanding how to plan for a system which will adequately meet such objectives, it is necessary to consider how the organization operates internally in addition to how it interacts with its environment. King [Ref. 19:p. 132] states that

> Both internal and external constraints must be identified if MIS Planning is to be effective. These constraints will emanate both from outside and within the organization.
>
> The most obvious forms of external MIS constraints are...reporting requirements and the need for the MIS to interface with other systems.
>
> Internal constraints emanate from the nature of the organization, its personnel, practices, and resources...[many] organizational characteristics serve to limit the MIS's scope and nature. For instance, the degree of complexity with which the system is incorporated may be constrained because of the limited sophistication of management, the lack of experience within the management group with computers, or demonstrated distrust of sophisticated information systems.

The external constraints, such as NAMP reporting requirements and the ability to interface with interim and future systems are clearly necessary for NALCOMIS. Objectives 2 and 3 above address these requirements quite adequately.

If there exists a conflict between stated objectives, however, it appears to lie with the fourth objective (discussion of the first objective follows in the next section). Modernized management support is certainly a desirable objective of any MIS. NALCOMIS/OMA, because of its use of on-line, real-time computing, might surely be classified as modern. The amount of management support that it will provide, however, remains to be seen.

"The on-line, real-time nature of the system will provide the needed response time to support daily activities and provide timely information to local managers." [Ref. 3:p. 4] While this statement is somewhat general, it is important to realize that NALCOMIS is attempting to provide management support through on-line, real-time features.[1]

To a great extent NALCOMIS automates existing procedures. To change the maintenance data collection

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[1]Some of the reactions that maintenance managers have had with these features will be discussed in Chapter V. For now we will limit our discussion to the activities performed by the maintenance manager and the information he uses in performing them.

and reporting procedures that have evolved over time would be an enormous disruption of the maintenance effort at all levels. Therefore, it is reasonable to expect that NALCOMIS will, in many ways, resemble the existing (NAMP) manual system. This does, however, then cause one to wonder how much better off management decisions will be because of the new system.

Dickson [Ref. 20:p. 82] says that

> When a system provides information to be used in the managerial decision process, then it is a true information system...A true information system is not aimed at the processing of data as is a clerical system. Thus, payroll systems, accounts payable and receivable systems, and even many inventory systems, although computerized, are not information systems. Furthermore, an information system contains information, not data; the content of the system output is not a vast sea of numbers, but conveys a message to the decision maker.

While an endless number of equally sufficient definitions may be applied to management information systems and transaction processing systems, one could say that NALCOMIS/OMA fits the definitions of both. There may be no clear distinction in the case of NALCOMIS/OMA. But what could be argued is to what extent will NALCOMIS/OMA provide management support?

2. <u>Decision Making in the Squadron</u>

Different levels of the hierarchy involved in aviation maintenance require different information. The Aircraft Controlling Custodian and Type Commander usually require reports which contain very aggregate

and summarized data (refined and summarized so that the data becomes meaningful information). The Commanding Officer of the squadron, while still interested in reviewing those same reports, will often require that somewhat more detailed information be supplied to him. The Maintenance/Material Control Officer, Maintenance Chief Petty Officer, and work center supervisors, on the other hand, sort through much data in order to obtain the information required to make their decisions.

Generally speaking, the further down the chain of command one moves, the more detailed the data becomes. This generality occurs due to the nature of decisions which must be made at each level in the chain of command. Data becomes information when, somehow, it is manipulated so that it becomes meaningful [Ref. 18:p. 9]. This information, then, is used for making decisions. It follows that, since different types of decisions must be made at different levels in the hierarchy, different information is required throughout the chain of command.

a. Types of Decisions

Lucas [Ref. 21:p. 29] identifies three types of decisions which are made in organizations: strategic, managerial control, and operational control. By examining each of these categories briefly, we will

be better able to understand how NALCOMIS can help improve decision making at the squadron level.

> The first area is strategic planning in which the decision maker develops objectives and allocates resources to obtain these objectives. Decisions in this category are characterized by long time periods and usually involve a substantial investment and effort.
>
> Decisions that are classified as managerial control in nature deal with the use of resources in the organization and often involve personnel or financial problems. For example, an accountant may try to determine the reason for a difference between actual and budgeted costs.
>
> Operational control decisions deal with the day-to-day problems that affect the operation of the firm. What should be produced today in the factory? What items should be ordered for inventory?

Lucas further describes the characteristics of the information that is associated with the three types of decisions mentioned (see Table 1) [Ref. 21:p. 29]. Information which is used in making strategic decisions, for example, is typically "predictive and long range in nature." Data which comes from sources external to the organization is often used. Also, "summary information on a periodic basis [may be] adequate."

Historical information, most often gathered from within the organization, is used in making operational control decisions. Lucas also points out that "the data...must be detailed. Because we are working with the day-to-day operations of the firm,

operational control information is often required in close to real time."

TABLE 1

INFORMATION CHARACTERISTICS VERSUS DECISION TYPES

	Decision type		
Characteristics	Operational control	Managerial control	Strategic planning
Time frame	Historical	⟶	Predictive
Expectation	Anticipated	⟶	Surprise
Source	Largely internal	⟶	Largely external
Scope	Detailed	⟶	Summary
Frequency	Real time	⟶	Periodic
Organization	Highly structured	⟶	Loosely structured
Accuracy	Highly accurate	⟶	Not overly accurate

As shown in Table 1 [Ref. 21:p. 29], the information required in making managerial control decisions takes on characteristics somewhere between those of strategic planning and operational control. Some managerial control decisions might call for detailed information while others may only require summarized information.

b. Classifying Maintenance Decisions

It might be difficult to classify each decision made within the OMA as one of the three types mentioned above. There is not always a fine line between an operational control decision and a managerial control decision. Some generalization, however, might be possible.

Strategic planning decisions, for the most part, take place outside the squadron. Certainly, most strategic decision making takes place outside the maintenance department. Operational and managerial control decisions, on the other hand, take up a great deal of maintenance managers' time. Since we are trying to determine how maintenance managers can best be provided with management support, our discussion will focus on operational and managerial control decisions.

Managerial control decisions can be thought of as taking place within the OMA primarily between the Department Head (Maintenance Officer) and the Division Officer levels. The Material Control Officer, for example, might be concerned that the squadron's operational cost per flight hour for the current quarter is well above that of the previous quarter. He may examine numerous factors in trying to determine a cause for the increase: the type of missions flown this quarter; the price of aviation fuel; unusual maintenance tasks, etc. Once he is satisfied that he knows what caused the increase, he can then make a decision as to what action should be taken (or, to take no action).

Somewhere below the division officers in the squadron's chain of command, operational control

decisions are made--those decisions dealing with the "day-to-day problems" which exist in the squadron. The Maintenance CPO, for instance, is constantly analyzing and prioritizing discrepancies (needed repairs or other maintenance actions). He decides which work center should receive each discrepancy, which aircraft should be repaired next, when scheduled maintenance can be performed--decisions which require constant awareness of the overall maintenance situation.

Work center supervisors, likewise, must be aware of the situation within their own work centers. They must know who is qualified (and available) to work on a particular discrepancy, what priorities exist within the work center--how to best employ their resources.

The management decisions which take place within the Maintenance Department, then, are primarily of the operational and managerial control types. It would, therefore, seem most beneficial to place the appropriate amount of development emphasis on ensuring that NALCOMIS supports those decision making functions.

3. Supporting Management with NALCOMIS

As we move down the management chain of command from the Maintenance Officer to the maintenance CPO and work center supervisor, the need for information generally changes to that which is more detailed and

real-time in nature than that which is reported outside the command. It might prove helpful, therefore, to examine current plans for NALCOMIS/OMA and try to determine whether or not those plans are likely to provide managers with the type of information necessary to improve their decision making.

a. Managerial Control Decisions

As stated earlier, it is difficult to make generalizations concerning the information required to make managerial control decisions. Sometimes the information is required to be real time and detailed, while other times summary information is sufficient.

NALCOMIS/OMA, as currently proposed, will certainly offer at least some benefits to those making managerial control decisions. Pre-defined reports should be received with little manual effort and hopefully with some greater speed and accuracy. Notice that greater accuracy implies "less chance for conflicting data" and not necessarily "more correctness." As long as there are human sources of data involved, there is chance for incorrect data.

One report currently available to management is the Not Mission Capable Supply/Partial Mission Capable Supply (NMCS/PMCS) Report which gives a daily listing of aircraft which are awaiting parts from the supply system, the supply documents which requested the

parts, and the status of those documents. This report is usually published so that it is available at the beginning of each morning work shift, and it gives maintenance managers an overall view of how the supply situation will affect their maintenance plans for the day.

One of the greatest benefits of NALCOMIS at the squadron level will be the interface it will provide between the Supply Support Center (SSC) and the OMA. Maintenance Chiefs constantly require information on the status of parts and components which are on order from the supply support center. By knowing when these parts will be delivered to the squadron, the maintenance CPO (and other managers) will be able to make decisions concerning cannibalization actions and schedule commitments. An on-line interface with Supply should give more timely forecasts of delivery times and dates. Such an interface, in addition to allowing the tracking of supply documents, will also speed up the process of ordering itself.

NALCOMIS must provide reports to the decision makers which contain the right information (and in the right format), and its on-line features must be fast and easy to use. In other words, NALCOMIS/OMA must provide squadron managers, from the Maintenance Officer to the division officers, with

better support than they are receiving with the current manual system.

b. Operational Control Decisions

As we move further down the squadron's chain of command--to the maintenance CPO and work center supervisors--the decisions which are made require even more detailed, real-time data. These decisions, once again, are operational control decisions.

Those making the day-to-day decisions will also have two basic ways of obtaining information from NALCOMIS: by report (or notice) and on-line. But as more and more detail is required by these managers, it will become more likely that pre-defined reports will not satisfy their information needs.

Very often, data reported up the chain of command is of little benefit (in its reported form) to those making operational control decisions within the squadron. All too frequently, the less experienced local manager is even unaware of the purpose that such data will serve. Some reports are viewed more as unnecessary paperwork than useful reports.

Since the reports generated by NALCOMIS/OMA will be pre-defined, their value to lower level management might be questioned. As Beishon [Ref 22:p. 311] states:

> In a situation where our understanding of how a man does his job is very limited, it is surely rather dangerous to make *a priori* judgements about the information he is going to need. Perhaps more important still, there is a more serious danger in deciding arbitrarily about the information we think he will not need and which, in consequence, we keep from him. Management is still rightly regarded as a peculiarly human skill precisely because, although we can aid the manager, we cannot replace him by explicit sets of rules for action, or even by mathematical equations. Since we, and to a large extent managers themselves, do not consciously know how they reach their decisions or why they make a good rather than a bad one, we must be especially careful in limiting or formalising their information sources. In the absence of specific research findings in the area it would, on the face of it, seem more sensible to allow the manager more freedom to build up his own information system on a trial and error basis and to study these systems in the light of their effectiveness.

It is reasonable to expect that maintenance managers will want (and, in many ways, need) the ability to examine and manipulate some data in a manner that will accommodate the ways in which they make individual decisions. (See chapter VIII for further discussion on manipulation of data.)

Since NALCOMIS does not allow managers to freely create and format their own reports [Ref. 10], some other way of satisfying their information requirements must be made available. In the absence of the capability of creating customized reports, the on-line capabilities of NALCOMIS/OMA must provide quick and easy access to the information needed to make decisions.

B. NALCOMIS AND "MISSION CAPABILITY"

NALCOMIS/OMA will attempt to improve mission capability in a couple of ways [Ref. 3:p. 3]. First, through "more accurate and timely processing of data, the organizational levels will be able to better manage and take action on the information provided by the system [NALCOMIS]." Secondly, by reducing "delays due to awaiting maintenance (AWM) and awaiting parts (AWP)," a greater aircraft availability (and, thus, mission capability) can be achieved.

Improving decision making and reducing delays due to AWM and AWP, while critical to increasing mission capability rates, are not the only things that information technology can do to improve mission capability at the OMA. It is possible that automation could also improve productivity at lower levels--particularly at the work center level.

It is the purpose of this section to show that mission capability depends on worker productivity as well as good decision making. After discussing maintenance and operational commitments which exist at the squadron, we will suggest what NALCOMIS/OMA must do in order to improve worker productivity and, as a result, improve mission capability rates.

1. Maintenance and Operational Commitments

There is a distinct relationship between maintenance tasks and operational commitments in the OMA. While operational commitments are usually known well in advance, maintenance on naval aircraft most often takes place as a result of the unexpected failure of some component or subsystem in the aircraft. Such failures make the management of naval aircraft maintenance difficult and filled with uncertainty.

Maintenance tasks can be classified as belonging to one of two categories: "scheduled" or "unscheduled" maintenance. Scheduled maintenance is defined as "periodic prescribed inspection [or] servicing of equipment, done on a calendar, mileage, or hours of operation basis." [Ref. 7:p. C-38] "Maintenance, other than the fix phase of scheduled maintenance, occurring during the interval between scheduled downtime maintenance periods," is unscheduled maintenance [Ref. 7:p. C-44].

Similarly, for purposes of this thesis, we might classify operational commitments as either planned or unplanned. Planned commitments are those commitments which are known well in advance, e.g., those which can be worked into a monthly operational plan. Unplanned commitments are those which are scheduled on lesser notice. For example, a squadron

might be called upon to provide tanker support when another previously committed squadron is unable to provide a tanker for the mission.

It is useful to think in terms of a simple two-by-two matrix while considering the effects of the possible combinations of occurrences on the organization and its personnel. There are four possible combinations (see Table 2): planned-scheduled, unplanned-scheduled, planned-unscheduled, and unplanned-unscheduled.

TABLE 2

	OPERATIONAL COMMITMENTS	MAINTENANCE TASKS
1)	planned	scheduled
2)	unplanned	scheduled
3)	planned	unscheduled
4)	unplanned	unscheduled

In a planned-scheduled situation, both Operations and Maintenance are operating under the greatest degree of certainty. Coordination between the two departments is high, and as a result, missions are completed and there are minimal pressures on the organization and its individuals. Unfortunately, this situation occurs too infrequently.

The unplanned-scheduled scenario presents less certainty, but the situation is still quite manageable. Through minimal coordination, Operations simply asks

Maintenance whether or not it can handle the extra commitment, and a yes/no decision is made. While a Commanding Officer would prefer to provide air support any time he is called upon to do so, his decision is based on how many aircraft are available.

The planned-unscheduled combination occurs most frequently. (The Maintenance Master CPO in the squadron visited during research for this thesis estimated that this situation occurs approximately 85% of the time.) Operational commitments are known well in advance but aircraft systems fail according to Murphy's Law. This situation is marked by schedule pressures and flight cancellations, both brought on by the uncertainty generated by aircraft going down. Pressure is on not only Operations to prioritize and rewrite its flight schedule, but on maintenance managers and work center personnel to fix the aircraft as well.

The last case, unplanned-unscheduled, while occurring less frequently than the previous case, again puts pressure on both departments. The maximum degree of uncertainty involved makes it difficult for the Operations Officer to decide whether or not he can accept an added commitment. He does not want to turn down a commitment that he can possibly meet, and yet, at the same time, he does not want to commit to a

mission and then be faced with the embarrassment of explaining why he missed it after all.

While these mixes of operational and maintenance situations occur in various combinations at any one time, it is interesting to note that the most frequent occurrence, planned-unscheduled, also places pressure on the organization and its individuals. Decreased mission completion rates and mission capability are the results.

2. <u>Benefitting From Automation</u>

How, then, should NALCOMIS/OMA, serve to improve upon the mission capability of the squadron? Although it cannot directly reduce the frequency with which aircraft systems break down, it could contribute to improved management decisions and free workers and work center supervisors from some of their administrative workload. Besides the importance of making fast, correct decisions about aircraft maintenance (by managers at every level), the other critical factor which is necessary to improve mission capability is worker productivity.

a. Better Decision Making

Providing useful and timely information to maintenance managers is one of the ways in which NALCOMIS will contribute to improved mission capabili-

ty. When managers have the right information at the right time, they can make better decisions.

As mentioned previously, NALCOMIS must provide maintenance managers with information pertinent to the decision at hand when it is needed. If this information is provided, then NALCOMIS has done all that it can be expected to do to help in the decision making process. Whether or not the correct decision is made will depend upon the decision maker himself.

At the work center level, the work center supervisor also makes decisions which affect mission capability. He must decide which personnel should be assigned to certain jobs, which discrepancies need to be repaired next, etc. He must be provided with (or seek) the pertinent information to make those decisions.

b. Productivity

Worker productivity also influences mission capability rates. Productivity does not depend upon information as much as decision making does, though. The primary factor in determining productivity is simply how much constructive time workers spend repairing aircraft discrepancies. Aircraft cannot be repaired by proper management alone. Manpower is required.

Productivity does depend somewhat on information, however. For instance, time is not spent very productively, if, in trying to fix a discrepancy, a worker replaces a component that was not faulty in the first place. Possessing the wrong information or interpreting information incorrectly can lead to decreased productivity. Productivity, nevertheless, depends mostly on workers spending as much of their time as possible directly on aircraft repairs.

What sort of activities take workers away from direct maintenance? While this question was not addressed in great detail during the research trip to the OMA, these activities should be identified to determine what, if any, help NALCOMIS/OMA can provide in reducing time spent on these activities.

One quite obvious group of activities was noticed during the visit to the OMA, however. These activities, which can be termed administrative tasks, consist, to a large extent, of collecting, documenting, and verifying data.

The VIDS/MAF, as will be seen in chapter VI, is one of the current means of collecting data. Data is entered on the form and checked for accuracy and validity by numerous individuals throughout the maintenance department--for each single discrepancy which is discovered. At the work center level, any

amount of time which can be saved in collecting, entering, and verifying data on the VIDS/MAF can be spent in the actual repair of aircraft. This could amount to quite a significant amount of time when the large number of VIDS/MAFs handled by the squadron is considered.

What NALCOMIS must do for the worker, then, is provide fast and easy access to the system, fast and accurate data entry, and check the worker's entries for validity. If NALCOMIS does not provide these services in a way which is better than the current manual system, then it is questionable whether NALCOMIS can significantly improve mission capability.

C. NALCOMIS/OMA OR EXPANDED NDS?

The Navy Management Systems Support Office and the NALCOMIS program manager (PMA-270) have expressed uncertainty as to the future of Phase III development [Ref. 10]. Due to the long-term costs involved in developing and maintaining NALCOMIS/OMA as currently planned, the following question has been posed: Should NALCOMIS/OMA, as currently defined, be further developed and tested, or should the NALCOMIS for Detachments Subsystem (NDS) become a basic building block and expanded as necessary to meet the requirements of larger maintenance activities [Ref. 13]?

In this section, the question of whether or not NDS should be expanded to meet the needs of all squadrons, and not just smaller detachments, will be examined by contrasting the grand-design and piece-at-a-time design approaches [Ref. 17:p. 26]. Also, some of the criteria for determining an effective baseline system are presented.

1. Complexity of NALCOMIS/OMA

During several visits to a typical O-level maintenance activity, maintenance managers were asked, "Have you heard of NALCOMIS?" The reply most often heard was, "Yes, I've heard about it for years but I've never seen anything on it." While this response is understandable, the feelings of maintenance managers toward NALCOMIS were usually one of several commonly held views:

1) Either they held no strong opinion of the system,

2) They felt that the system is so complex that they may never see it completed, or

3) They expect to see NALCOMIS at the squadron level, but perceive the delay as being indicative of some dreadfully complicated system that will just have to be dealt with someday.

Almost without exception, however, each individual agreed that a better way of collecting and handling maintenance data is needed. Many also felt that a computer system is the logical choice to handle the

complex administrative tasks required of today's Naval Aviation squadrons.

The OMA is unique in that it is, in many ways, a self-contained unit which carries out not only maintenance activities, but operational and administrative activities as well. While it is dependent upon other organizations for support and policy guidance in each of these areas, it is nonetheless unique.

What this unique structure means is that a fully integrated MIS for the OMA has the possibility of being extremely complex. Besides needing information processing and management capabilities for each of the individual activities mentioned above, all three activities must be capable of interacting with one another to some extent if the OMA is to possess a full MIS capability.

Even an information system which were to be limited to only the Maintenance Department would be very complex by nature. Just as interdepartmental exchanges of information take place among the Maintenance, Administrative, and Operations departments, intradepartmental exchanges take place within the Maintenance Department itself. This potential complexity becomes important in deciding just how much information system should be heaped upon the OMA initially.

2. Grand-Design versus Piece-At-A-Time

There are several reasons why a complex MIS such as NALCOMIS/OMA (as currently planned) might not be successfully implemented within the OMA all at once. Besides the users' resistance to change, several other factors make initial delivery of a basic, no-frills system an attractive alternative.

1) A complete MIS takes longer to develop than a system with less capability. The longer development time of a more complex MIS could mean delays in delivery of some smaller baseline system to fleet users.

2) Delivering NALCOMIS/OMA all at once would mean that less feedback on the system's performance could be incorporated into the initial version. While prototyping would have taken place, it would be desirable to receive feedback on a baseline NALCOMIS while other subsystems were being developed and phased into the OMAs.

3) Problems would be more easily corrected in a less complex system. It would be most desirable to have any problems in the initial NALCOMIS/OMA resolved before a fully integrated MIS were installed.

Robert Head [Ref. 23:p. 95] states in "The Elusive MIS" that

> Most practitioners agree that a system of major scope, especially one that cuts across organizational lines and involves numerous organizational components, should be implemented gradually. Rather than work toward a day several years in the future when an entire grandiose scheme goes "on stream," it is better to implement the system in chunks or pieces.

Booth terms these two approaches "the grand-design approach" and "the piece-at-a-time approach" [Ref. 17:p. 26]:

> The grand-design approach...can ensure that all functions and all parts of the system fit together well. In addition, in-depth analysis of the entire system prior to implementation ought to minimize the possibility of surprises--discovering new requirements after implementation has begun, or even after it is complete.
>
> The piece-at-a-time approach...is often...appreciated by system users. System users and their management generally like this approach because they receive some payback in system benefits relatively quickly. They are also less likely to face traumatic changes as each piece of the total system is implemented. If changes in operational methods and/or the structure of the organization are required, it may be possible to make these modifications gradually.

Booth also states that "the piece-at-a-time approach is particularly advantageous--and the grand-design approach especially risky" when trying to implement poorly understood functions, such as those performed by managers. He concludes that "the probability of creating a truly successful system may be higher with this method [the piece-at-a-time approach] than with the grand-design approach."

3. Determining a Baseline

Ideally one would hope that NALCOMIS/OMA could be delivered to the user at the same rate at which it was gaining his acceptance. Although it would be virtually impossible to precisely determine this rate, it would be desirable, particularly in a large and/or complex system, to develop and deliver a baseline system first and deliver subsequent subsystems at a later date. A baseline system is a system which

performs some set of useful (and satisfactory) functions but which at initial delivery does not perform functions which are considered less critical to the maintenance organization. If that baseline system could be determined, it might not only help users in their acceptance of the system, but it could also allow the basic system, with no shortcuts in design, to be delivered in considerably less time than that required for the whole system.

Besides lessening the impacts of a new system on the end user and shortening initial development time, such a baseline system offers several other advantages. If, during implementation testing, the system were found to be unworkable for some reason, wasted resources would be limited to those of a basic, no-frills development. In addition, subsequent subsystems could be developed and delivered while taking advantage of lessons learned from previous subsystems.

If a baseline system for NALCOMIS/OMA is to be built, then developers will have to answer several questions in order to determine the most appropriate subsystems for the baseline system:

1) Which modules <u>must</u> be built first? This would include any modules which are necessary for the existence of the system.

2) Which modules are dependent upon or depend on other existing modules?

3) Which modules do we strongly desire to include in our first version of NALCOMIS/OMA?

Parnas [Ref. 24:p. 312] says that "one first searches for the minimal subset that might conceivably perform a useful service and then searches for a set of minimal increments to the system." He also points out that

> the identification of the possible subsets is part of identifying the requirements...[This is] especially important to government officials who purchase software...they are forbidden by law to tell the contractor how to perform his job. They may tell him what they require but not how to build it. Fortunately, the availability of subsets may be construed as an operational property of the software.

Although a purely skeletal system might not be very useful to OMAs, building a NALCOMIS/OMA which would perform the most basic, but effective, functions would be useful. Parnas even states that while the minimal subset is useful, "it is usually not worth building by itself." What NALCOMIS must be is a foundation system which can meet today's squadron needs effectively and be further built upon as those needs change and even increase.

4. <u>Making NALCOMIS Effective</u>

Brookes [Ref. 16:p. 5] identifies five attributes which an information system must possess to be truly effective:

> Decision-oriented reporting--meaning that output from the system is designed to facilitate decision making by those persons who receive the output.

Effective processing of the data--indicating that the checks and controls on input and output are appropriate, system timing is meaningful in the context of the application, and the utilization of the hardware and software environment is efficient.

Effective management of the data--e.g., requiring attention to be paid to: the timing of file updates, the accuracy of input data, controlled redundancy, the maintenance of integrity once data are stored within the system, the security requirements while the data are being used and on disposal, and appropriate back-up facilities.

Adequate flexibility--i.e., it is possible to meet changing needs of the organization because the system can be updated as new computing technology becomes available, and can adapt to changes in the behavioural characteristics of those persons associated with it.

A satisfying user environment--those responsible for the system's design make sure that the machine-people interfaces are appropriate for the tasks involved.

That NALCOMIS/OMA should possess these attributes, in addition to performing some set of basic useful services, is in keeping with what was said earlier in this chapter. NALCOMIS/OMA should "make a major impact on a key area associated with the success of the business" [Ref. 16:p. 98]--and at the OMA, that business is providing mission capable aircraft. In order to make a sufficient impact on the mission capability rates, the effectiveness of NALCOMIS/OMA is key.

5. Analyzing Current Plans

Will NALCOMIS/OMA, as currently planned, prove to be an effective system for improving mission

capability at the squadron level? Now that we have identified some of the characteristics that it must possess to do so, how can we decide whether or not these current plans are adequate?

Since no computerized system exists at the organizational level, it could be very difficult to prove or disprove the adequacy of these current plans. But there is one possible source which might help in such an analysis--NALCOMIS Phase II.

As stated previously, many of the functions performed at the OMA are also performed at the Intermediate Maintenance Activity as well. While there are inherent differences, such as schedule pressures, work environment, etc., there are enough similarities to make such a comparison useful.

Although the Phase II system is still being introduced to the fleet, testing of the system software has been going on since as early as February 1986. In addition, "prototype operations commenced in August 1986." [Ref. 6] There are, therefore, personnel who have gained some experience with the Phase II system.

The next chapter contains a summary of interviews with some of these individuals. Those interviewed were also quite knowledgeable with respect to organizational level maintenance procedures and, as a result, qualified to evaluate some of the Phase II

features in terms of the OMA. These interview results will later be used in our attempt to reveal some of the strengths and weaknesses of current plans.

D. SUMMARY

Many decisions face those involved in the management and development of NALCOMIS/OMA. Some of the issues associated with the following three of these decisions have been discussed in this chapter:

1) How can NALCOMIS provide management support to squadron maintenance managers?

2) What can NALCOMIS do at the squadron level to improve mission capability?

3) Should NALCOMIS/OMA be further developed or should NDS be expanded to meet the needs of the OMA?

If NALCOMIS is to adequately support squadron maintenance managers, it must provide, in a timely fashion, information that is useful in making decisions. But different types of decisions are made throughout the chain of command.

The types of decisions made in an organization can be classified as either strategic planning, managerial control, or operational control decisions [Ref. 21:p. 29]. Within the OMA the decisions are primarily of the managerial control and operational control types.

Managerial control decisions, which occur most predominantly between the Maintenance Officer and Division Officer levels of management, "deal with the

use of resources in the organization and often involve personnel or financial problems." Some of these decisions require detailed, real-time information, while others require less timely, summary information.

Operational control decisions, on the other hand, "deal with the day-to-day problems that affect the operation of [the squadron]." These decisions usually require detailed information which is closer to real-time.

NALCOMIS primarily supports reporting of information to higher levels of authority. Since this information is often of limited value to squadron managers, and because current plans for NALCOMIS/OMA will not allow managers to create customized reports [Ref. 10], some other feature of the system must allow decision makers fast, easy access to the information which is needed. If customized reports cannot be provided, then the on-line retrieval of this information must be made available.

NALCOMIS/OMA will attempt to improve mission capability through "more accurate and timely processing of data" and by reducing "delays due to awaiting maintenance (AWM) and awaiting parts (AWP)." [Ref. 3:p. 3] There is another factor which determines mission capability, however--worker productivity. If NALCOMIS/OMA can contribute to relieving some of the

administrative burden at lower levels, particularly at the work center level, mission capability will likely increase as a result.

NALCOMIS/OMA, however, cannot significantly contribute to freeing workers from administrative burden unless it provides a faster means of collecting, recording, and validating data than the current paper system. If work center personnel must deal with a cumbersome, time consuming system of data collection, then they will be less able to contribute to improved mission capability by spending more time repairing aircraft discrepancies.

Finally, five attributes required for an effective information system were identified [Ref. 16:p. 5]:

1) Decision-oriented reporting.
2) Effective processing of the data.
3) Effective management of the data.
4) Adequate flexibility.
5) A satisfying user environment.

In the following chapters, these five attributes will become the basis for analyzing the current plans for NALCOMIS/OMA. After presenting the results of interviews with NALCOMIS Phase II system users and other organizational level maintenance managers, the current plans will be evaluated to try and determine just how effective NALCOMIS/OMA will be at meeting its objectives.

V. USER CONCERNS

The previous chapter identified some of the characteristics that NALCOMIS/OMA must possess in order to be an effective information system and contribute toward improved mission capability. It is easy to evaluate a system which has already been built. But since we are trying to determine beforehand whether or not NALCOMIS/OMA will possess those characteristics, the evaluation becomes more difficult.

Although NALCOMIS/OMA has not yet been built and, consequently, there are no experienced NALCOMIS/OMA users, there is one group of users that might prove very helpful--Phase II users. As previously mentioned, Phase II is currently being introduced to the fleet. As a result, there are personnel who have gained experience with the system during evaluation and testing.

Since many of the functions performed at the Intermediate Maintenance Activity (IMA) are similar to those performed at the OMA, some of the Phase II users were interviewed with the hope of gaining an understanding of the functions which will be included in NALCOMIS/OMA. The users who were interviewed were

especially qualified since they also had extensive experience in organizational level maintenance.

This chapter contains the results of these interviews. After providing a description of the users and the circumstances under which the interviews were conducted, a summary of the results will be presented by specific problem area. Later, in chapter VIII, these results will be used to determine some of the strengths and weaknesses of current plans for NALCOMIS/OMA.

A. THE INTERVIEWS

A three day research trip to NAVMASSO (Norfolk, Virginia) in October 1987 provided valuable background information on NALCOMIS/OMA. Since the trip was limited to such a short period of time, however, very little time was available for conducting interviews with Phase II users. Most of the available time was spent researching current Phase III documents and talking with personnel who were (and had been) involved with Phase III plans.

Interviews were conducted with users of the Phase II system for two main reasons. First, it was hoped that by gaining knowledge of how the Phase II system worked, some knowledge of NALCOMIS/OMA would also be gained. The second reason was to identify some of the

potential problems that exist in current plans for automating the OMA.

Ms. Nancy White, head of the Systems Integration and Documentation Division at NAVMASSO, set up the interviews. She was asked to provide the most knowledgeable persons available who 1) had used the Phase II system, 2) had extensive experience in organizational maintenance, and 3) could best answer questions about potential problems that might be encountered at the OMA.

1. Profiles of the Users Interviewed

There were three Phase II users who best qualified for the interviews. The following provides a profile of those interviewed at NAVMASSO:

USER A

Rate: E-7

Aviation maintenance experience: 5 years OMA; 7 years as a work center supervisor at both OMA and IMA; 1 year experience as a maintenance controller

System experience: 1 year Phase II; approximately 60 hours experience on the contractor's Phase III prototype

USER B

Rate: E-7

Aviation maintenance experience: 9 years OMA; 4 years IMA including work center supervisor; 1 year in Production Control

System experience: 1 year Phase II testing and evaluation

USER C

Rate: E-7

Aviation maintenance experience: 14 years OMA including 9 years as work center supervisor, 1 year as a QAR, and 3 months as maintenance controller

System experience: 7 months Phase II testing and evaluation; approximately 60 hours experience on the contractor's Phase III prototype

In addition to these interviews, a fourth user was recommended by the above three as having exceptional knowledge about the Phase II system. Because this user was assigned to MAG-14, MCAS Cherry Point, N. C., it was impossible to interview him in person. Telephone interviews, however, were conducted with this user. His profile is given below:

USER D

Rate: E-7

Aviation maintenance experience: 5 years OMA; 3 years IMA

System experience: continuous Phase II experience from May 1986 to present

2. The Nature of the Interviews

It was explained to each subject that the purpose of the interviews was to learn how the Phase II system worked. Additionally, users were told that, through the similarities between the Phase II and Phase III systems, it was hoped that some insight might be gained as to how NALCOMIS/OMA might serve to improve

mission capability and provide management support at the OMA.

Those interviewed were asked open ended questions. For example, each was asked to describe how NALCOMIS Phase II is used, how it compared with the current paper system, and what major problems, if any, they saw in the system. Any responses that seemed especially surprising were followed up with more specific questions.

In the months following the initial interviews, follow-up interviews were conducted by telephone. These follow-up interviews included questions intended to clarify earlier discussions, answer new questions, and verify earlier statements by those interviewed.

B. RESULTS OF THE INTERVIEWS

The interviews revealed a number of common concerns among the users of the Phase II system. Each user, fully aware that the research was being conducted in the area of NALCOMIS/OMA, discussed only those functions which were common to both Phase II and the planned Phase III systems. The results of these interviews, categorized by problem area, is contained below.

1. Users' Expectations

Users A, B, and D each independently stated that the user must know and understand the NAMP. While

maintenance personnel (including managers) are expected to know how the NAMP operates, many do not. Often, maintenance personnel fail to distinguish local procedures from those which are directed by the NAMP.

Since NALCOMIS is designed with the NAMP in mind, there are only limited functions that will be performed. Therefore, a thorough understanding of NAMP procedures and knowledge of what NALCOMIS is capable of doing is necessary in order to prevent frustrations within the organization. Dickson [Ref. 25:p. 4] refers to this difference between "what is expected and what occurs" as the "expectations gap."

An understanding of the NAMP and current manual procedures is also necessary in the event that NALCOMIS breaks down. Even if the highest degree of reliability is achieved by NALCOMIS hardware and software, the organization must be prepared to revert to a paper system, being fully aware of procedures, information flows, and how to properly fill out paper forms. These users felt that, in order to be ready to shift to a contingency mode at any time, a VIDS board (discussed in Chapter VI) will have to be maintained and updated at all times. User B felt that it might be necessary to maintain a current VIDS board not only within Maintenance Control, but within each work center, as well.

2. Ease of Use

Although screens and conversations are designed with ease of use in mind, User B felt that learning to use NALCOMIS may present a problem to new users. Users A, B, and D doubted that, even after NALCOMIS/OMA has been delivered and in use for a reasonable period of time, it will be relatively easy to use.

The period of time immediately following fleet delivery will, of course, be the most frustrating, with the entire maintenance organization learning and adapting to the new system. The high pressure environment of aviation maintenance, coupled with new procedures, will prove most challenging. User A, although experienced with the Phase II system, was observed using paper aids in parallel with the system. He used a list of codes, for example, to guide him through the necessary conversations.

User D said that "lots of printouts are being used by people utilizing the system." He cited lists of codes (e.g., VIDS/MAF codes, job status codes) as being used quite often. Most alarming, however, was his statement that personnel are using printouts "because going to the appropriate menu screens is just too much time and trouble."

3. <u>Will the Automated VIDS/MAF Really Save Time?</u>

Each individual user of the system must sign-on with his own unique password. If Petty Officer Smith is signed-on and currently working on a task, what happens if he is distracted momentarily, for example, to answer the telephone? Another user, Petty Officer Jones, meanwhile, enters the work center with some urgent task, breaks Smith's connection, and signs on himself. Jones is now finished with his task and then Smith returns. According to User B, Smith must now sign-on and re-enter the lost data before completing his task.

Users B and D stated that a queuing problem can also potentially develop any time more than one user within the work center needs access to the system at the same time. Other than finding an available terminal in another work center, the only alternative available to users in the queue is to wait on the current user to finish. With the paper VIDS/MAF system, however, many different workers are able to pull the appropriate MAFs from the VIDS board, complete the paperwork, and move on to the next task.

User D, the interviewee with the most NALCOMIS Phase II operational experience, noted that queuing is "our biggest problem. Avionics is our largest work

center, and, therefore, is most likely to have numerous personnel trying to update a MAF at the same time."

Even with the individual user, it is often much faster to pull a paper MAF, make a pen entry, and replace the MAF. With an automated MAF, however, it is necessary to take a certain amount of time to log onto the system and go through the appropriate conversations.

User A stated that the maintenance control manager (e.g., Maintenance CPO) is constantly looking at the master VIDS board to make his decisions. He has a major concern with the way in which the system presents data on screen. He doubts whether the big picture of maintenance can be as easily drawn from screen outputs as is currently done with the VIDS board. Perhaps managers will eventually learn how to best extract the information that is needed, but he felt that, as currently designed, much more effort is required with the automated system than with the visual paper system.

User A felt that the extra effort required to gain an overall view of the maintenance situation might require more personnel in Maintenance Control. He also expressed doubts that one terminal within Maintenance Control would be adequate since the maintenance effort is so dependent on the VIDS board for decision making.

He thought that as many as three terminals might be required to allow Maintenance Control to keep up with all of the information necessary to coordinate the maintenance effort: one terminal to keep track of and make inquiries regarding the present maintenance situation; one for sending mailbox messages (i.e., concerning MAF control numbers, priority messages, etc.); and one for use by the Logs and Records personnel. A fourth terminal might even be required if Naval Aircraft Flight Records (Yellow Sheets) are used in the maintenance control area (as is done with the current paper system).

4. Ignoring the System

As mentioned earlier, there are many instances when a paper MAF system might be faster and require considerably less effort than a computerized system. Users A and C were concerned that there might be a real danger here that personnel will attempt to bypass, or intentionally ignore, NALCOMIS. Their biggest fear was that simple discrepancies might not be written up at all.

The aviation maintenance environment is, most often, one filled with heavy schedule pressures. Extra pressure might be added to the situation when one is faced with the possibility of missing an aircraft

launch because NALCOMIS is slow or momentarily inaccessible.

User A illustrated the effects of such pressures using the following example. Consider what might happen when the determination is made, just prior to scheduled takeoff, that drop tanks are required on an aircraft. If the worker, already under pressure to et the launch commitment, is unable to find an available terminal, he might choose to do the job without using NALCOMIS at all. He may ignore the system rather than wait on an available terminal, go through all of the necessary conversations, and finally complete the MAF--and miss the scheduled takeoff time.

Besides documenting all of the work done on an aircraft, the MAF serves to ensure that all of the proper maintenance has been performed so that an aircraft is safe for flight. Even the simplest maintenance tasks require that qualified personnel check the quality of work performed. If NALCOMIS were ever ignored by maintenance personnel, safety could be jeopardized.

5. Security

Further concern that people might ignore or improperly use NALCOMIS dealt with security. Fears were expressed by Users B and C that, for example, passwords would freely be handed from one person to

another for the sake of convenience. User B said that he could envision a situation in which "a list of passwords is given to one person." For instance, a work center supervisor might obtain the password of a Collateral Duty Inspector and Quality Assurance Representative (QAR), in order to quickly and conveniently sign off a MAF.

An additional security concern was that if users were allowed to choose their own passwords, other personnel might easily access the system under a false identity. If a QAR chose something easy to remember for his password, say a nickname or his birth date, then someone else with knowledge of the QAR's account (or access to that knowledge) might compromise the system. User A suggested that a random password generator could be used to assign passwords rather than having personnel choose their own.

User C said that the possibility of system compromise should be a cause for alarm among those responsible for safety of flight items. After the occurrence of an aircraft mishap, what are the legal implications of the new system? It might become very difficult to prove or disprove claims by an individual that his password had been compromised. A type of electronic forgery, therefore, could become a very real threat and an issue difficult to resolve. Before a

similar situation arises, it might serve well to discuss such issues with the Naval Aviation Safety Center.

6. Purging of Data

The Quality Assurance division of the OMA, for tracking and analysis purposes, often relies on historical data. What will happen when QA needs data that has been purged from the data base? User A expressed concern that retrieving the data necessary for such analyses may be a very time-consuming process. Will the periodic purging of the NALCOMIS data base mean that retrieval of such data will seem not worth the effort to QA personnel? User A felt that, at best, QA will keep hardcopy printouts and continue its analysis efforts manually.

7. Management Support

There was a general feeling among the users that the system does not provide much management information. Again, this depends upon what data the individual uses to arrive at his decisions. But User A felt that some of the subsystems could be cut down in size, quite possibly in order to make room for more management information. He perceived NALCOMIS as containing double documentation (often, the same data existing both electronically and in paper form) and unnecessary data.

User A also stated that some NAMP programs, such as the Hydraulic Contamination Control Program and Oil Analysis programs, for example, must still be done manually. Similarly, there appears to be little provision for Quality Assurance tracking and trend analysis, which might take priority, in his opinion, over existing Technical Publications provisions.

8. Other Concerns

A problem of less critical nature, but still a genuine concern, was expressed by User A. Suppose, for instance, that a portion of the squadron goes on detachment from the 1st through the 29th of the month. The detachment, using a paper MAF system, returns with a high volume of data (on paper VIDS/MAFs) which must be processed in a very short period of time (for end of the month reporting). Many hours of additional (and duplicative) effort would be required for necessary, historical purposes.

With the exception of planned down time, each of the users felt that the Honeywell hardware was very reliable. Prevailing, however, was the feeling that response time was a "bit slow." In addition, User B said that printing hardcopy documents on some of the available printers seemed "very slow."

C. SUMMARY

The concepts which are encompassed in current plans for NALCOMIS/OMA are seen by present and potential future users as being both necessary and highly desirable. Automation and the resulting changes in procedures are viewed as worth the effort. There was a consensus among the Phase II users and the squadron maintenance managers who were interviewed that an automated maintenance system is long overdue.

While the Phase II users who were interviewed have been intimately involved with development and testing of the system, and, therefore, will be more knowledgeable about NALCOMIS than ultimate fleet users, there is no reason to expect that the system cannot be accepted by the fleet once these and other critical management issues are adequately resolved.

While intended as only a brief synopsis of interviews with Phase II users, this discussion has hopefully provided some insight as to the nature of user-manager concerns that face the NALCOMIS/OMA. Although criticisms exist, users appeared patient and willing to work with the NALCOMIS until improvements are made. While there is no way to completely satisfy every user and manager at the OMA, many of the problems discussed (and others not discovered through these interviews)

will require attention, preferably prior to final system delivery.

VI. NAMP PROCEDURES

As stated in the previous chapter, squadron personnel do not always have a clear understanding of the differences between NAMP and local procedures. Those with less knowledge about the NAMP may know how to accomplish their jobs correctly, but do not necessarily know when they are performing a task in accordance with local, rather than NAMP, procedures.

The purpose of this chapter is to explain NAMP procedures for the collection and display of data within the OMA. Since a complete explanation of all NAMP procedures is well beyond the scope of this thesis, the discussion will focus on the Visual Information Display System/Maintenance Action Form (VIDS/MAF). The largest amount of data within the squadron is collected on this form [Ref. 7:p. 11-3].

After providing an explanation of the flow of the VIDS/MAF within the squadron, several of the potential benefits of changing from a paper to automated, on-line VIDS/MAF are identified and briefly discussed.

A. CONTROLLING MAINTENANCE

The NAMP provides maintenance managers with standardized procedures which help them efficiently manage their resources. To assist in doing so, the

Visual Information Display System (VIDS) was established to provide managers with the information necessary to control those resources while minimizing paperwork.

> The VIDS is a management tool that provides a graphic display of vital, up-to-date information on a continuing basis. The system correlates all aircraft status information, particularly NMCS/PMCS, flyable discrepancies, and assigns a relative importance to each item. The ability to review the overall situation and determine what resources are available enables the MO and MMCO, or supervisor, to carry out their duties more effectively and efficiently. [Ref. 7:p. 6-2]

VIDS boards are enlarged cardex type pockets for the visual display of weapon system status. Each pocket is overlapped by the one above so that approximately a 3/8-inch strip is visible at the bottom of the pockets [Ref. 7:p. 6-3]. While the exact set-up of the VIDS board is left to the discretion of the individual organization, the NAMP does require that IN WORK, AWM (awaiting maintenance), and AWP (awaiting parts) status be displayed by aircraft bureau/side number [Ref. 7:p. 6-3]. Typical VIDS board layouts found in a Maintenance Control are illustrated in Figure 2 [Ref. 7:p. 6-5].

"That portion of the maintenance organization's workload devoted to repair, Technical Directive compliance, and periodic/conditional inspections is the area in which there is the greatest requirement for data in depth." [Ref. 7:p. 11-3] This in-depth data is

SIDE NO. W/C	IN WORK	BUNO AWM	AWP
110			
120			
210			
220			
230			
310			

O-Level Maintenance Control Board (Using One Board Per Aircraft)

SIDE NO.	IN WORK	AWM	AWP
201			
202			
203			
204			
205			
206			

O-Level Maintenance Control Board (Side Nos.)

SIDE NO.	W/C	IN WORK	AWM	AWP
201	110			
	120			
	130			
	210			
	220			
	230			
	310			
202	110			
	120			
	130			
	210			
	220			

O-Level Maintenance Control Board (Side Nos. and W/Cs)

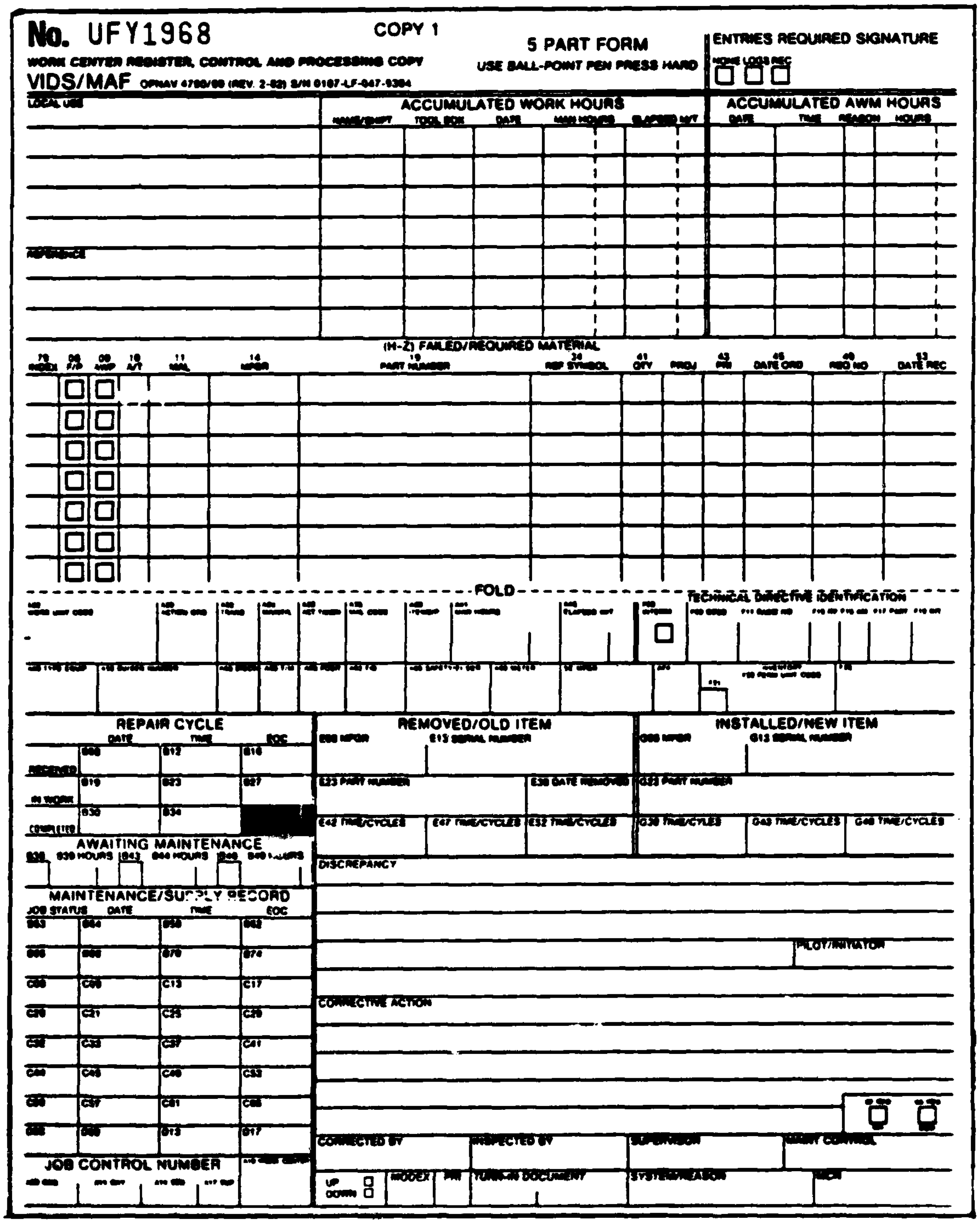
Typical O-Level Maintenance Control VIDS Boards

Figure 2

collected during the maintenance process on the Visual Information Display System/Maintenance Action Form, or VIDS/MAF (Figure 3). It is the VIDS/MAF which is placed in the card slots on the VIDS board. By placing the VIDS/MAF on the VIDS board under the appropriate aircraft, work center, and status (i.e., IN WORK, AWM, AWP), maintenance managers can obtain an overall view of the maintenance situation in order to make decisions as to how best employ their resources. By flagging each active VIDS/MAF with colored fillers while on the board, the manager can also see at a glance which discrepancies place the aircraft in either a Partial Mission Capable or Not Mission Capable status.

The VIDS/MAF (Figure 3) is a five part document. Each copy is identical to the other with the exception of copy 2, which only contains that information found on the lower half of the MAF. After the MAF is initiated and Maintenance Control has determined what sort of action is required, the MAF is separated and copies distributed as appropriate. A more detailed explanation of MAF distribution follows in the next section.

In addition to the master VIDS board found in Maintenance Control, each work center is also required to maintain a VIDS board for those MAFs which pertain to that work center. As with any duplication of data,



No. UFY1968 COPY 1

5 PART FORM

USE BALL-POINT PEN PRESS HARD

ENTRIES REQUIRED SIGNATURE

WORK CENTER REGISTER, CONTROL AND PROCESSING COPY

VIDS/MAF

LOCAL USE

ACCUMULATED WORK HOURS

ACCUMULATED AWM HOURS

REFERENCE

(H-Z) FAILED/REQUIRED MATERIAL

FOLD

TECHNICAL DIRECTIVE IDENTIFICATION

REPAIR CYCLE

DATE TIME EOC

RECEIVED

IN WORK

COMPLETED

REMOVED/OLD ITEM

INSTALLED/NEW ITEM

AWAITING MAINTENANCE

DISCREPANCY

MAINTENANCE/SUPPLY RECORD

JOB STATUS DATE TIME EOC

PILOT/INITIATOR

CORRECTIVE ACTION

CORRECTED BY

INSPECTED BY

SUPERVISOR

MAINT CONTROL

JOB CONTROL NUMBER

The VIDS/MAF

Figure 3

there exists a possibility that some of the data contained on the work center board is in conflict with the master VIDS board. Therefore, the work center must verify, on a daily basis, that the information contained on the master board is the same as that contained in the work center.

Maintenance Control also maintains, for each aircraft, an Aircraft Discrepancy Book (ADB). "The ADB is designed to provide maintenance and aircrew personnel with an accurate, comprehensive, and chronological record of flights and maintenance performed on a specific aircraft...for at least the last 10 flights" [Ref. 7:p. 6-7] As will be seen, the ADB provides this record by containing VIDS/MAFs written against that particular aircraft. Those VIDS/MAFs contained in the ADB must also be verified against the Maintenance Control and work center VIDS boards to ensure accuracy.

During several visits to a typical OMA, maintenance managers estimated that somewhere between 80-90% of all VIDS/MAFs were initiated due to corrective maintenance. Because there are such a large number of different type maintenance actions which are recorded on the VIDS/MAF, and since repairs account for such a large percentage of the organization's workload, the focus of this research was placed on discrepancy MAFs--those MAFs

which are initiated due to a need for corrective maintenance on an aircraft.

B. DISCREPANCY VIDS/MAF FLOW

Figure 4, taken directly from the NAMP, Vol. II, illustrates the flow of the VIDS/MAF document within an O-level Maintenance Activity. The following comments, derived from the NAMP and a visit to an organizational maintenance activity, are numbered to correspond with Figure 4 [Ref. 7:p. 6-8]:

1. Initiates VIDS/MAF

a. Pilot or Other VIDS/MAF Initiator

The pilot, or other maintenance person discovering the discrepancy, initiates a VIDS/MAF by filling out the following blocks of information:

A48, TYPE EQUIP--A four-character code that identifies the end item (e.g., aircraft, engine, etc.) being repaired.

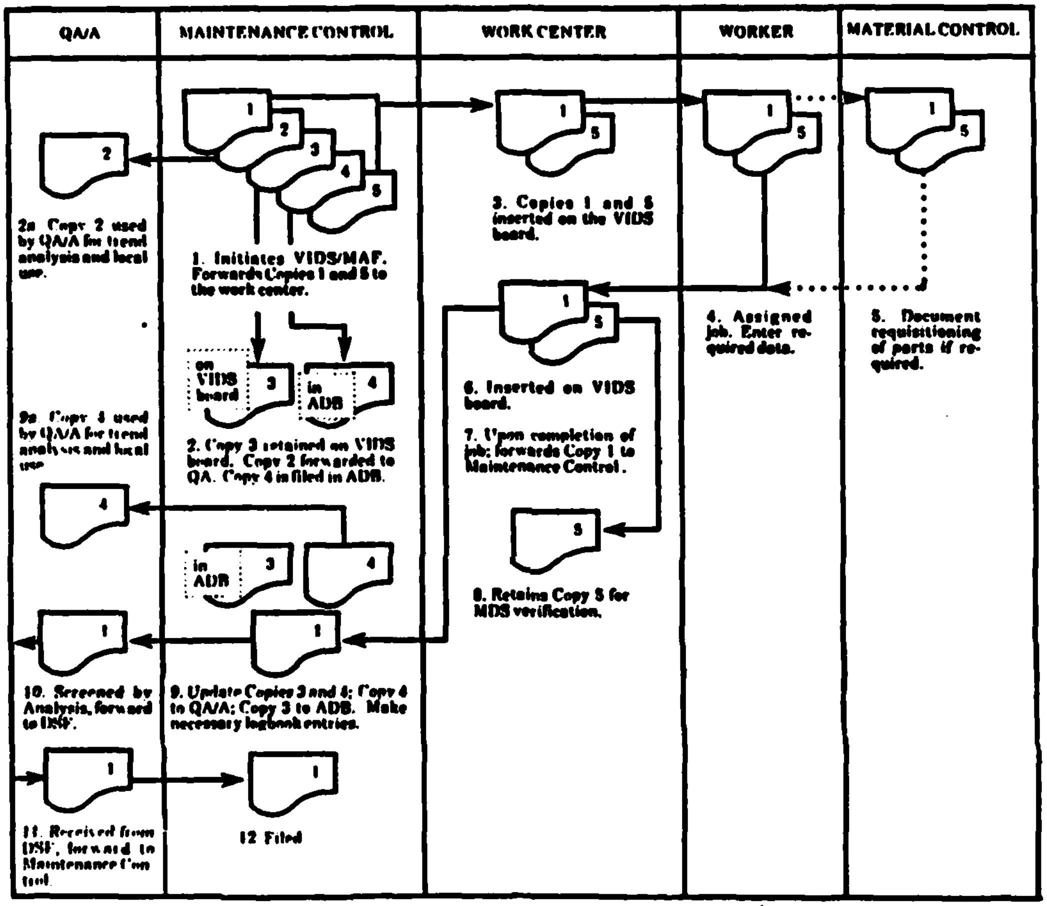
A52, BU/SER NUMBER--The serial number of the item being repaired. Aircraft, for example, are assigned a six-digit number.

A58, DISCD--A single alpha character describing when the need for maintenance was discovered.

DISCREPANCY--A concise, written description of the discrepancy.

PILOT/ INITIATOR--The name and rate (or rank) of the individual initiating the VIDS/MAF.

B08 & B12, RECEIVED DATE-TIME--Julian date and time that the MAF is initiated.



O-Level Maintenance VIDS/MAF Document Flow Chart

Figure 4

b. MCPO Assigns the Work Center

By reading or listening to the description of the discrepancy (and, if needed, discussing it with the MAF initiator), the MCPO decides which work center is responsible for the needed repair and whether the discrepancy places the aircraft in a down status. He then appropriately completes blocks:

A19, WORK CENTER--A three-character code used to identify the work center performing the required maintenance.

UP/DOWN--The appropriate block is checked to indicate the status of the equipment.

A59, T/M--A one-character code describing the type of work to be performed (e.g., scheduled, unscheduled, etc.)

c. VIDS Board Clerk

The VIDS board clerk completes any further required information. One such block, MODEX, is a three-digit number used locally to identify an individual aircraft. Modex is also referred to as the aircraft's side number.

The VIDS board clerk also assigns a Job Control Number (JCN) which uniquely identifies each MAF. The JCN includes blocks:

A08, ORG--A three-character code which identifies the organization.

A11, DAY--The last tree digits of the julian date which identify the day of the year.

A14, SER--A three-character, locally assigned serial number. By assigning serial numbers sequentially, each JCN becomes a unique number.

The copies of the VIDS/MAF are separated....

2. Copy 3 Retained on VIDS board

Copy 3 is placed on the master VIDS board in Maintenance Control and copy 4 is placed in the appropriate ADB.

2a. Copy 2 is Delivered to QA

Copy 2 is delivered to QA where it is placed in the trend book awaiting completion of the maintenance action.

3. Copies 1 and 5

a. Work Center

Copies 1 & 5 are sent to the appropriate work center where they are placed on the work center VIDS board. The work center supervisor, in examining his VIDS board, prioritizes his jobs according to what discrepancies need to be corrected in order to get an aircraft up or ready for the next mission. Maintenance Control, depending on the situation, may direct the work center supervisor as to which jobs have the highest priority.

b. Work Center Supervisor Assigns Job

Then, considering such factors as the physical location of the aircraft, safety considerations, and the time available to work on the aircraft, the work center supervisor assigns the job to a qualified maintenance man.

4. <u>Assigned Job</u>

The worker, as proceeding with the job, fills out the appropriate data sections on copies 1 and 5:

ACCUMULATED WORK HOURS--Used to account for man-hours spent on repairing the discrepancy. Also used to document that an inventory of tools has been performed upon return to the work center.

A22, WORK UNIT CODE--Identifies the specific system, subsystem, or component which is being repaired.

A29, ACTION ORG--A code indicating the organization accomplishing the work.

A32, TRANS--A two-digit code which identifies the type of data being reported

A34, MAINT/L--A single digit (1, 2, or 3) indicating the level of maintenance performed.

A35, ACT TAKEN--A one-character code describing the action that has been taken (i.e., repair, remove and reinstall, etc.)

A36, MAL CODE--Three-character code which indicates the malfunction which caused the repair to take place.

A39, ITEMS/P--The number of items processed (e.g., replaced or repaired).

A41, MAN HOURS--The total number of man-hours expended in order to complete the repair.

A45, ELAPSED M/T--The total clock time (not man-hours) required for the repair.

B19 & B23, IN WORK DATE-TIME--The Julian date and time that work is begun on the discrepancy.

B30 & B34, COMPLETED DATE-TIME--Julian date and time that the repair is completed.

CORRECTIVE ACTION--A description of the action taken to correct the discrepancy.

CORRECTED BY--Signature and rate of the worker (or crew leader) performing the maintenance.

INSPECTED BY--Signature and rate of the Quality Assurance Representative or Collateral Duty Inspector who inspects the job.

SUPERVISOR--Signature and rate of the work center supervisor. This signature indicates that Quality Assurance and tool control requirements have been met.

5. <u>Document Requisitioning of Parts</u>

If parts need to be ordered, then the worker obtains supply and status information from Material Control and records the information on the MAF.

6. <u>Inserted on VIDS board</u>

The VIDS/MAF is placed under the AWP section of the VIDS board until the required parts are received.

7. <u>Upon Completion of Job</u>

Upon completion of the job, the worker signs off the maintenance action, obtains other signatures (i.e., CDI, QAR) as required. The work center supervisor checks the MAF for accuracy and completeness and forwards copy 1 back to Maintenance Control.

8. <u>Retains Copy 5</u>

Copy 5 is retained in the work center until the Maintenance Data Report (MDR) containing that MAF is received from the Data Services Facility. Once that copy has been verified against the MDR to ensure that the data on each document corresponds, it is destroyed.

9. <u>Update Copies 3 and 4</u>

a. VIDS Board Clerk

Once the MAF is signed off by the work center supervisor and copy 1 is returned to Maintenance Control, the VIDS board clerk pulls copies 3 & 4 from the VIDS board and ADB. The VIDS clerk then transcribes the following blocks from copy 1 onto copies 3 & 4:

A22, WORK UNIT CODE

A29, ACTION ORG

A32, TRANS

A34, MAINT/L

A35, ACT TAKEN

A36, MAL CODE

A39, ITEMS/P

A41, MAN HOURS

A45, ELAPSED M/T

B19 & 23, IN WORK DATE-TIME

B30 & B34, COMPLETED DATE-TIME

CORRECTIVE ACTION

CORRECTED BY

INSPECTED BY

SUPERVISOR

Copies 3 & 4 are then signed under the MAINT CONTROL block. Copy 3, which now denotes a discrepancy which has been corrected, is placed in the ADB for the

pilot's review. Once ten flights have been completed on the aircraft, copy 3 is removed and destroyed.

b. Logs and Records

Copy 1 is then sent to the Logs and Records section. The Logs and Records clerk first checks certain data blocks for accuracy and completeness:

MODEX and A52 (Bureau Number) are checked to ensure that they correspond.

A22 (WORK UNIT CODE) is checked to ensure it contains the correct number of digits.

A29, A32, A34, A35, A36, and A39 are checked to ensure completion.

A41, MAN HOURS, and A45, ELAPSED M/T, are checked against the ACCUMULATED WORK HOURS block for arithmetic errors.

A48, A52, A58, and A59 are checked for correctness.

REPAIR CYCLE times are checked to ensure they are reasonable.

c. Log Entries Made

Next, the clerk decides whether or not a log entry is required. If so, then depending on the type of entry required by the NAMP, he uses the appropriate data from the following VIDS/MAF blocks for his entries in the aircraft logbook:

REPAIR CYCLE (dates and times)

DISCREPANCY

A22, WORK UNIT CODE

REMOVED/OLD ITEM section (blocks E08-E52)--If a repairable component has been removed from an aircraft (or other end item), this section contains data specific to that component.

INSTALLED/NEW ITEM section (blocks G08-G48)--If a repairable component has been installed on an aircraft (or other end item), this section contains data specific to that component.

The Logs and Records clerk then checks the logs and records blocks under the ENTRIES REQUIRED SIGNATURE section and signs the VIDS/MAF. He then forwards copy 1 to the Analyst in QA.

9a. <u>Copy 4 Used by QA/A</u>

Copy 4 is forwarded to QA. By matching this copy with copy 2, QA is assured that the discrepancy has been completed. It now uses copy 4 to complete its collection of data to be used in trend analysis. In doing so, QA uses the following blocks:

A19, WORK CENTER--A three-character code used to identify the work center performing the required maintenance.

MODEX--A three-digit number used locally to identify an individual aircraft.

A52, BU/SER NUMBER--The serial number of the item being repaired. Aircraft, for example, are assigned a six-digit number.

DISCREPANCY--A concise, written description of the discrepancy.

CORRECTIVE ACTION--A description of the action taken to correct the discrepancy.

A35, ACT TAKEN--A one-character code describing the action that has been taken (i.e., repair, remove and reinstall, etc.)

A36, MAL CODE--Three-character code which indicates the malfunction which caused the repair to take place.

PILOT/ INITIATOR--The name and rate (or rank) of the individual initiating the VIDS/MAF.

CORRECTED BY--Name and rate of the worker (or crew leader) performing the maintenance.

INSPECTED BY--Name and rate of the Quality Assurance Representative or Collateral Duty Inspector who inspects the job.

SUPERVISOR--Name and rate of the work center supervisor.

A11, DAY--The last tree digits of the julian date which identify the day of the year.

a. QAR Receives and Checks Copy 4

When copy 4 is received, QA looks first at block A19 to determine which QAR should receive the MAF. That QAR then enters the appropriate data on a trend sheet which he uses to track discrepancies which fall under his area of expertise. The trend sheet is discussed in more detail in the next chapter.

The QAR also checks the data (such as blocks A35 & A36) to ensure that it is consistent with the discrepancy and corrective action taken.

10. Screened by Analysis

The QA Analyst screens copy 1 to ensure that the MAF is legible and contains no errors. While some errors escape the analyst, his job is to minimize errors before the VIDS/MAF is sent to the Data Services Facility (DSF) for processing. These copies are typically delivered to the DSF at least daily, sometimes twice daily.

11. <u>Received from DSF</u>

As the DSF receives VIDS/MAFs, operators keypunch all numbered items from the MAF onto tape. A second operator keypunches the same data for verification. Once a MAF is completed it is stamped by the DSF and returned to the QA Analyst. Daily reports, called Maintenance Data Reports (MDRs), are sent to the squadron, where they are distributed to work centers for verification against copy 5 of the VIDS/MAF. Any corrections to the MDR are annotated and the MDR is returned to the DSF to be keypunched once again.

12. <u>Filed</u>

Copy 1, once fully completed and keypunched, is then kept in a historical file within the squadron in accordance with the NAMP, usually for a period of six months.

C. POTENTIAL BENEFITS OF AN ON-LINE VIDS/MAF

Upon study of the flow of the VIDS/MAF within the OMA, several potential advantages of an on-line system become apparent. Some of those advantages are:

1. <u>Reduction of Lost Paperwork</u>

It was noted by the VIDS board clerk in the squadron that sometimes copies of a MAF were lost, leading to either an extensive search for the paperwork or the tedious reconstruction of that copy. While data can certainly be lost in a computerized system, there

are advantages to the elimination of a five part document and the multiple distribution of those copies.

2. Elimination of the Physical Delivery of VIDS/MAF Copies

Delivery of paperwork throughout the department means that someone has to take time to walk into Maintenance Control, receive the MAF, and then return to his work center. While no time studies were conducted in this regard, there may be substantial savings to be had in this area.

3. Reduction of Entry Errors

Maintenance personnel reported that whenever an error was caught on a VIDS/MAF, time would often be required to track down the individual making the error in order to clarify his intended entry. Numerous fields on the MAF contain only a fixed number of possible valid entries. For example, a squadron is only assigned X number of aircraft at any one time. Therefore, there are only X number of valid entries for Bureau Number and Modex. An on-line system containing a module (specific to the type of aircraft operated by the squadron) might alert the user that he had made an error, allowing him to correct his entry on the spot.

4. Automatic Verification of Data

As illustrated in the previous section on VIDS/MAF flow, there are many people actively involved in validating data. The master VIDS board, work center

VIDS board, and the ADB must all contain the same data and, therefore, must be validated on a regular basis. Furthermore, the Logs and Records clerk and QA Analyst spend much of their time validating the VIDS/MAF for accuracy and completeness. A computer system capable of verifying these items would save many man-hours over a period of time.

5. Reduction in the Handling of Data

Outside the squadron, the Data Services Facility devotes much time to the double entry and correction of VIDS/MAF data, and the creation of reports which are provided to the squadron. If such corrections and reports were done at the squadron level (primarily on the computer), then the processing of the data could take place exclusively at the OMA.

6. Elimination or Reduction of a Number of Reporting Delays

A computerized, on-line VIDS/MAF could significantly reduce delays in reporting. If the input of data could take place exclusively at the OMA, then the time required to keypunch and verify data at the Data Services Facility would be eliminated. Also, reports could be made available to local managers more quickly by computer than by manual methods, as is currently done.

7. Possible Reduction of Requirements for Space in Which to Store Paper Forms

The storage of paper forms (blank and completed) takes up great amounts of space in the OMA. By storing forms and information on magnetic media, great savings in space is possible. These savings could prove particularly beneficial to aviation units when deployed aboard ship.

VII. LOCAL AND NON-NAMP PROCEDURES

Woolsey [Ref. 26:pp. 55-59] provides an enlightening account of one often overlooked, yet important, factor in determining system success--user (bottom-level management) acceptance. He states that even though there is a long-held view that top management commitment is the key requirement for system acceptance, bottom-level acceptance is equally as important.

Woolsey tells the story of a "systems czar" who was called into:

> a large midwestern manufacturing company to design, build, and gain acceptance for a wall-to-wall production control and reporting system for the whole plant. He was given virtual carte blanche to do it any way he wanted, a munificent salary, all the subordinates he needed, a budget, expected results, and a deadline. [Ref. 26:p. 55]

As a first step Woolsey's "czar" sought to find out exactly why other large systems of similar type had failed. What he found was that:

> whatever the level of acceptance by top management, the nonacceptance by the troops that had to deal with the system on a day-to-day basis was the key. More study showed that invariably the CRT displays and the listing to be used by the grunts down below were presented to them as a big surprise with the (usually implied) understanding that they should take it because "mother knows best"....
>
> Finishing his homework, he discovered what appeared to be a common thread among the failed systems. In every case where failure resulted, when the customary exercise of "soliciting lower management commitment" was finished, only the sharpest or most open-to-

> change management was tapped. The reasons are obvious: (a) who wants to listen to dummies, and (b) it's always easier working with people who are ready for change. [Ref. 26:p. 55]

The systems analyst then went about gathering two supervisors who had gone on record as being opposed to any new system and "were not exactly mental giants." After some initial complaining by the two supervisors, they then proceeded to tell the analyst that "for over twenty years they had been coming to work an hour early and sitting down over coffee and scheduling their two machine groups to try to minimize both setups and hassle to themselves." After finding out what the supervisors needed to reduce this hassle, the analyst, after three tries and much thought, "presented them with a computer-generated form in precisely the format that they could mark up in the most effective way for their scheduling."

By modifying the existing reporting system to generate this form, making a couple of subsequent changes to the format as requested by the men, and delivering the form to the two supervisors daily and in a timely fashion, the analyst found that production under the men began to soar. The supervisors, who had previously resisted any new systems, seemed now to become disgruntled only if their report was not on time. Woolsey concludes that this is how systems acceptance should be.

Woolsey's argument can be aptly applied to the NALCOMIS/OMA concept as well. A visit to an OMA revealed that managers at all levels within the organization used reports as tools in accomplishing their work. While higher-level managers like the Commanding Officer and department heads tended to use summary reports, such as AV-3M reports, lower-level managers tended to use more customized, local reports.

The purpose of this chapter is to show that, no matter how streamlined the initial version of NALCOMIS/OMA may be, it should provide managers with the ability to sort and format data in a way that is useful to them (as individual decision makers). Furthermore, managers should be able to easily change the format of such reports and have them available on an as needed basis (for example, daily or at the start of each shift).

A. MANAGEMENT TOOLS

In order to understand the need for such a capability, it is important to discuss some of the tools used by managers at various levels. The following discussion, although the result of study done at one OMA, serves to illustrate the importance of local reports and their contribution to proper management of resources.

1. <u>The Maintenance Control Shift "Passdown Log"</u>

Used primarily by the Maintenance Chief Petty Officer (MCPO), the purpose of the Maintenance Control Passdown Log (Figures 5a and 5b) is threefold:

1) Serves as a reminder of important information to be passed to the next shift's MCPO.

2) Aids the MCPO in coordinating work centers and maintenance control.

3) Used as a general management tool (as described below).

The Maintenance Master Chief Petty Officer at the OMA visited reported that, although not used by all OMAs, the passdown log is used by a majority of O-level activities. By marking in the log as progress is made on various jobs, the log is used as a minute-by-minute management tool during the shift. While it contains much of the same information contained on the VIDS board, the MCPO can obtain, at one glance, an overall view of the maintenance effort in order to prioritize his work.

Set up by aircraft side number (modex), the status of each aircraft (indicated by UP/DOWN arrow) is denoted, along with the discrepancies outstanding against those aircraft. By using colored pens, the MCPO can highlight each discrepancy which keeps the aircraft in a Not Mission Capable/Partial Mission Capable status.

4298 DX – NX 24 OCT 84

301: GEN FAILED ON DECK; CHANGING MASTER GEN SWITCH AND THEN LPTU√ AGAIN.

302: IF POSSIBLE, DROP √ TONIGHT, SAND { GRIND AND HAVE READY FOR WASH IN MORNING.

?04: FUEL FLOW MESSED UP AGAIN; PROBABLY BE "DOWN" TONIGHT. POT BUGEYE ANTENNA AFTER LAST RCVY.

305: NEXT CANDIDATE FOR STENCEL.

307: UP

310: SEAT INSTALLED. 105/210 DAY COMPLETE EXCEPT FOR: INSTALL CANOPY, LPTU √S, UP FOR TOMORROW.

313: SEAT INSTALLED; INSTALL CANOPY, BUILD-UP AFT CELL.

315: 40 DAY TONIGHT (TOMORROW).

Maintenance Control Passdown Log (left side)

Figure 5a

4298 DX TO NX 24 OCT 84

↑ 301 ~~GEN PATE~~ - ASST(120) - F/LK - HOOK LT - CAB PRESS -

↓ 302 40 DAY - ~~[illegible]~~ - ~~[illegible]~~ ~~[illegible]~~ - ~~H/B SAMPLES~~

303 (G40)

↓ 304 FUEL FLOW - AMF - AFC - F/LK - HUD - PMDS - BUGEYE ~~[illegible]~~ ~~10 HR~~
ARA 63 - RAD ALT - Throttle - ~~[illegible]~~ TONE

↓ 305 NMCS - REPRES NO ROB

306 (G40) NO ROB

↑ 307 AMF - E/SIGHT - SKID - F/LK - ~~[illegible]~~ ~~10 HR~~ AFCS - 01 UPDATE

↑ 310 ICS/310 NAV - ~~INSTALL SEAT~~ ~~INSTALL CANOPY~~ ~~[illegible]~~ - ~~[illegible]~~
L/BAR - ALT HOLD - SKID -

↓ 311 REPRES -

(GEN CONT PNL 301)
↓ 313 NMCS - REPRES - ~~INSTALL SEAT~~ ~~INSTALL CANOPY~~ - AFT CELL REBUILD -

314 (G40)

↓ 315 40 DAY - STBY COMP - APC% - SPD BK IND - DOPPLER - LITES ~~[illegible]~~
~~[illegible]~~ - GEN - ~~RAD PRESS~~ ~~[illegible]~~ - CANOPY LOCK - 10 Hr - ~~[illegible]~~
INST LITES DIMING PNL

Maintenance Control Passdown Log (right side)

Figure 5b

In prioritizing specific jobs, the MCPO looks for those discrepancies which are keeping an aircraft in a down (not mission capable) status and checks the VIDS board to see which jobs are currently in work. After all downing discrepancies are worked off, then the MCPO might prioritize jobs by determining either which remaining discrepancy is the most difficult to work off or which aircraft has the most discrepancies remaining against it.

The MCPO finds it difficult to provide a simple recurring algorithm to explain exactly how he makes his decisions. He also freely admits that other MCPOs, given the same information, might make slightly different decisions about how best to employ his resources. The MCPO, then, must be able to select that data which he feels will help him make the best decisions--thus, a customized tool such as the passdown log described here.

The log is also used to make the transition between workshifts one which is complete and smooth. If the maintenance department, while ashore, is working only two shifts, then the outgoing nightshift MCPO can also make any written comments intended as reminders for the incoming morning shift MCPO--for example, any extraordinary configuration changes or progress from that night.

Perhaps most advantageous to the MCPO is the use of the log book as a customized VIDS which contains only that information which the MCPO feels necessary to make his decisions. The MCPO also uses the log to conduct the maintenance meeting with work center supervisors at the beginning of his shift--again proving the value of such a tool to the MCPO.

Finally, it should be noted that other managers also find such a management tool useful. The Maintenance Officer, MMCO, and others can also be observed occasionally walking over to the passdown log to gain an overall picture of the current maintenance effort.

2. <u>The Daily Grind</u>

The Daily Grind (Figure 6), also broken out by aircraft side number (modex), is used by managers throughout the organization - the Commanding Officer, Maintenance Officer, Maintenance/Material Control Officer, MCPO, etc. Containing various statistics relevant to each aircraft, it is used to gain an overall feel for high-time components, phase inspections, engine times, oil samples, etc.

The grind has been developed in many squadrons through the use of a spreadsheet program on a microcomputer. The MCPO, when using the grind to make his decisions about which aircraft to schedule for

03-Dec-87 SQUADRON STATUS AS OF (TIME) 0000 JULIAN DATE 7337

MOD	BUNO	LAST FLOWN	MONTH FLT HR	A/C FLT HRS	CAT	TOT ARR	50 ARR	25 ARR	PHASE/ TYPE	40 DAY	ENG SERNO	ENG TSN	OIL SAMPLE	100 HR	200 HR	300 HR	ENG CHG
100	160000	16-NOV	0.0	4874.3	52	189	20	0	4974.9	09-JAN	140000	3994.6	4001.6	NA	NA	NA	4032.3
		17			48	61	30	25	100.6	37	D		7.0	NA	NA	NA	37.7
									A								
101	160001	24-NOV	0.0	4051.0	86	115	2	2	4100.0	02-JAN	140001	4602.1	4612.1	4707.0	NA	NA	4657.0
		9			14	135	48	23	49.0	30	D		10.0	104.9	NA	NA	54.9
									E								
102	160002	02-DEC	2.2	4193.0	82	19	19	19	4274.0	24-DEC	140002	[illegible]354.6	2358.9	NA	NA	NA	2404.0
		1			18	231	31	6	81.0	21	D		4.3	NA	NA	NA	49.4
									C								
103	160003	30-NOV	0.0	3845.9	0	60	33	8	3900.0	02-DEC	140003	3764.0	3768.6	3792.1	3892.1	3992.1	4192.1
		3			100	190	17	17	54.1	-1	D		4.6	28.1	128.1	228.1	428.1
									C								
104	160004	02-DEC	9.8	5405.2	59	55	32	7	5470.3	08-DEC	140004	4880.6	4886.9	4957.1	5057.1	5157.1	5357.1
		1			41	195	18	18	65.1	5	D		6.3	76.5	176.5	276.5	476.5
									C								
105	160005	02-DEC	8.5	5601.0	1	20	19	19	5639.5	13-DEC	140005	3496.4	3497.9	3503.4	3503.4	NA	3603.4
		1			99	230	31	6	38.5	10	D		1.5	7.0	7.0	NA	107.0
									C								
106	160006	04-NOV	0.0	5431.7	84	1	1	1	5364.1	20-DEC	NA	NA	NA	NA	NA	NA	NA
		29			16	249	49	24	22.4	17	D		NA	NA	NA	NA	NA
									D								
107	160007	20-OCT	0.0	4557.5	NA	22	12	12	4666.2	26-NOV	NA	NA	NA	NA	NA	NA	NA
		44			NA	228	38	13	108.7	-7	D		NA	NA	NA	NA	NA
									D								
110	160008	02-DEC	11.2	3552.1	57	210	1	1	3547.1	15-DEC	140006	4767.5	4774.1	4794.9	4894.9	4994.9	5194.9
		1			43	40	49	24	25.0	12	D		6.6	27.4	127.4	227.4	427.4
									F								
111	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		NA			NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA
									NA								

The Daily Grind

Figure 6

maintenance, does so with a great deal of caution. Although a quite useful tool, the grind is subject to human error and must be verified regularly to ensure that the data it contains is correct. If, for instance, the grind incorrectly shows the number of carrier arrested landings remaining on a particular aircraft, then the maximum allowable landings on the aircraft's hook point might be exceeded.

Once again, the grind does not present any information that cannot be derived from the VIDS board or other sources, it merely contains data presented such that it helps the manager make better decisions more quickly. Additionally, as new managers come into the organization, the spreadsheet format of the daily grind can be changed to best meet their needs.

3. The Daily Status Report

While Functional Wings and Air Wings require reports summarizing aircraft status to be submitted on a daily basis, the reports that they require vary in format and actual content, depending on the Functional or Air Wing Commander's desires. The information contained in these Wing reports are typically what the OMA wants the Wing to see. Figures might be somewhat manipulated out of fear of the Wing attempting to micromanage the squadron. In other words, these reports tend to be favorable rather than actual

snapshots of the activity's maintenance effort. They are, then, not very valuable to squadron maintenance managers.

Almost without exception, however, squadrons produce, in addition to a Wing status report, a separate daily status report (Figure 7). The squadron's daily status report contains, not what the OMA wants the Wing to see, but information which accurately represents the true maintenance situation in a format useful to them. Just as the Functional Wing Commanders request status information in a form that is most useful to them, squadron Commanding Officers and Maintenance Officers come up with a status report that best meets their information needs. Besides containing basic summary information on aircraft status, such a report might also reveal the status of primary mission subsystems, thus becoming useful not only to the Maintenance Department but also to the Operations Department.

4. Quality Assurance Trend Sheet and Trend Analysis Report

When a Quality Assurance Representative (QAR) receives copy 2 of a VIDS/MAF, he places it in a trend book. Then, after corrective action has been taken on the discrepancy and he receives copy 4, he enters data from the MAF on a trend sheet (see Figure 8). In this manner he keeps a record of those discrepancies

Daily Aircraft Status Report Date: 7 Dec 87

	M	T	W	T	F	S	S	AVG	
ASSIGNED	9								
ON BOARD	9								
"A" STATUS	8								
MC	4								
FMC	4								
NMCS	3								100/103/107
NMCM	1								102
PERCENT MC	50								
PERCENT FMC	50								
PERCENT NMCM	12								
NMCS REQ'N	7								
PMCS REQ'N	4								
CANNIBALIZATIONS	8								
FLIGHT HOURS	22.2								

	NC	FNC	AFCS	APC	AILS	ACLS	AHRN	ALR 45F	ALQ 126	ALE 39	RADAR	AMF	FLIR	GUN	DISCREPANCIES	REMARKS
100	↓	↓	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	×	↑	IFR ADAPTER	
101	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	×	↑		
102	↓	↓	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	×	↑	ENGINE PULLED, INS, INLET SEAL	
103	↓	↓	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	×	↑	ENGINE PULL	
104	↑	↑	↗	↑	↑	↑	[illegible]	↑	↑	↑	↓	↑	×	↑		
105	↑	↑	↑	↑	↑	↑	[illegible]	↑	↑	↑	↑	↑	×	↓		
106	↓	↓	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	×	↑	G40 ENGINE	
107	↓	↓	↑	↑	↑	↑	[illegible]	↑	↑	↑	↑	↓	×	↑	MULTI-NORS	
110	↑	↑	↑	↑	↑	↑	[illegible]	↑	↑	↑	↑	↑	×	↑		

FLIR PODS 01 ↓ 02 ↑ 03 ↓ 04 ↑ 05 ↑ 06 ↑ 07 ↓ 08 ↓

FLEDS LINE 001 ↓ 002 ↓ 003 ↑ 004 ↑ 005 ↑ 006 ↑ 007 ↑ 008 ↑

Daily Status Report

Figure 7

TREND SHEET

AIRCRAFT SIDE NO. ________ AIRCRAFT BUNO ________ SYSTEM ________

JOB CONTROL NUMBER (JCN)	DISCREPANCY	ACTION TAKEN

The Trend Sheet

Figure 8

occurring which apply to his particular area of expertise.

Once data collection for a specific period of time (e.g., a month) is complete, the QAR can then go through his trend book and construct a trend analysis report (see Figure 9) in the format preferred by the squadron. Interested primarily in recurring discrepancies, he may construct such a report by aircraft, subsystem, or even by pilot.

Although Maintenance Data Reports (MDRs) received from the Data Services Facility provide valuable QA information, QARs find it useful to construct their own custom trend/analysis reports. In addition, some items of interest to the QAR are not found on the MDR (for example, unnumbered blocks on the VIDS/MAF).

5. The Monthly Maintenance Plan

Required by the NAMP, the Monthly Maintenance Plan (MMP) provides scheduled control of the predictable maintenance workload for the squadron (Ref. 7:p. 6-12). Although distributed outside the command, it is used primarily by managers within the command from the work center supervisor up to the Commanding Officer. In addition to the minimum amount of information required by the NAMP, Maintenance Officers often add

information to it that they feel will help in their planning for the short to medium range.

MONTH ____________ QAR ____________

	HUD	PMDS	IMS	FLIR	HARM	RADAR
100						
101						
102						
103						
104						
105						
106						
107						
110						

Trend Analysis Report

Figure 9

6. The 3-M Supplement

The monthly 3-M report, which is a summary of Maintenance Data Reports (MDRs), is supplemented by this report. Also required by the NAMP, the maintenance analyst assembles the 3-M Supplement from MDR data to give the MMCO and work center supervisors a view of man-hour accounting within the organization. The 3-M Supplement can also reveal whether or not work center supervisors are correctly documenting man-hours within their work centers.

In the OMA visited during research for this thesis, the Analyst was found to be using a microcomputer software package (LOTUS 123) to produce graphs included in the Supplement showing how the squadron compared with other Pacific fleet squadrons in the areas of:

1) Mission Capability
2) Cannibalizations/100 Flight Hours
3) No. Defects/100 Flight Hours
4) Aircraft Utilization
5) Corrosion Control/Treatment
6) Equipment In Service Hours

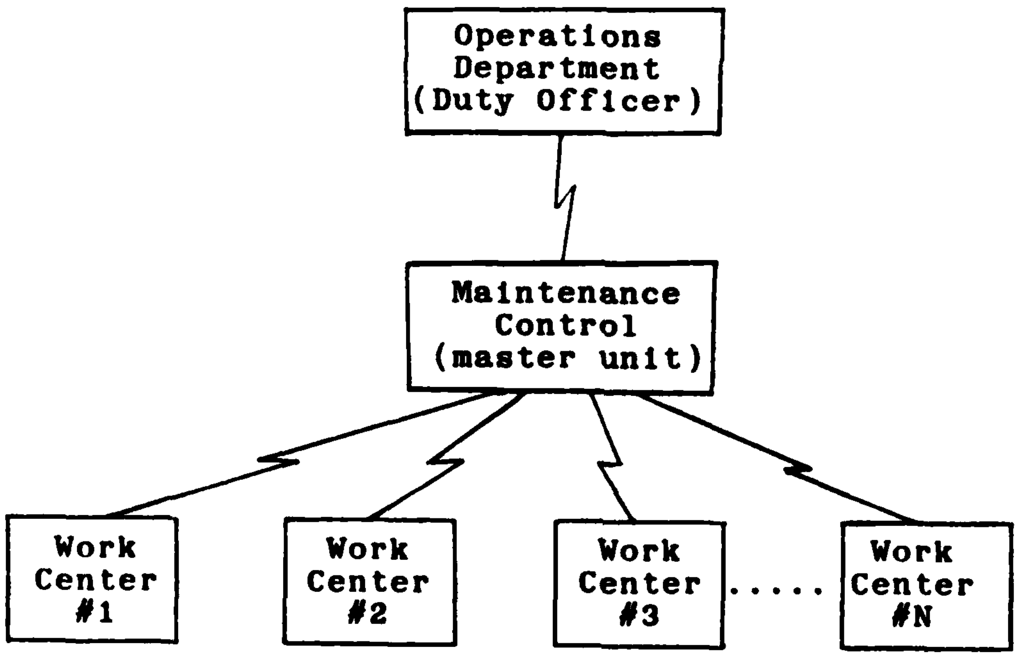
Although this discussion has been limited to just a few examples of reports being used for management within the squadron, there were other customized reports being used by this command. According to the Maintenance Master Chief Petty Officer of the squadron visited, other squadrons also use such customized aids. These and other tools, while extracted from data that already exists in some other form in the squadron, are assembled by time-consuming manual methods with occasional help from microcomputer programs. By allowing the manager to manipulate data and format reports according to local needs, NALCOMIS can save those involved with such reports much time and effort--time and effort which equates to greater productivity.

B. THE INTERCOM SYSTEM

Senn [Ref. 27:p. 16] points out the importance of recognizing informal channels and critical communication links within an organization when designing information systems. One very important element that exists at the O-level maintenance activity is the intercom system.

The MMCO in the squadron visited during research stated that every OMA uses an intercom system. The master unit is located in maintenance control with a slave unit in each work center. There is also an additional slave unit located in the squadron's operations duty office (see Figure 10). In this particular OMA, the master unit is capable of communicating with any slave unit, but each slave unit may only communicate with the master unit in maintenance control.

The type of communication taking place between the Operations Department (the duty officer) and maintenance control varies somewhat between ship and shore operations. This difference is mainly due to the fact that, while shore based, the duty officer is usually in communication with the pilot. When aboard ship, there is usually no radio link between the duty officer and the pilot. Therefore, certain information, such as



The Intercom System

Figure 10

status of the aircraft, cannot always be passed from the duty officer to maintenance control.

Information which gets passed back and forth from maintenance control to the work centers, however, does not change significantly when changing from ship to shore operations. While no study was conducted with regard to the volume and type of exchanges between maintenance control and work centers, the MMCO indicated that the intercom system was "an extremely valuable tool which is used constantly. We couldn't get along without it."

The maintenance chief petty officer (MCPO) and those assisting him within maintenance control use the intercom to gain information necessary to make minute-by-minute decisions. A quick call to a work center can provide the real time status of a particular job. Another call to the work center supervisor can reveal to the MCPO which individuals are available (and qualified) to perform a specific task. The MCPO can often quickly locate an individual or piece of equipment by calling all work centers at once.

While the intercom may not be considered when referring to NALCOMIS/OMA, it will continue to play a role in squadron decision making. The intercom will become, although not in a formal sense, a part of NALCOMIS/OMA. As will be shown in the next chapter,

this communication tool between maintenance control and work centers should be considered when deciding which functions of the OMA to automate.

C. NALCOMIS/OMA AND LOCAL REPORTING

Plans for NALCOMIS/OMA do not include any capabilities for creating reports at the squadron level. It will be possible to generate predefined reports to be sent to the Type Commander, Functional Wing, or even the squadron. However, it will not be possible for a maintenance manager within the squadron to create new reports.

There are several reasons why providing local managers with the ability to create reports might appear undesirable to those managing the development of NALCOMIS/OMA:

1) Providing such capabilities could increase development time and cost.

2) Someone would have to maintain the software modules which are responsible for formatting and producing the reports [Ref. 11].

3) Data base integrity could be jeopardized. If a user became too knowledgeable in learning how to manipulate data, he might alter the data base in an undesirable manner [Ref. 10].

While there is no doubt that providing the capability to produce local management reports would take extra development effort, it is necessary to consider the benefits of such capabilities to the OMA.

A brief illustration of the importance of user acceptance to system success was provided at the beginning of this chapter. Certainly, providing features to NALCOMIS/OMA (at a reasonable cost) which would increase user acceptance would be highly desirable. There are several other reasons why automating local reports would be beneficial.

First, man-hours are already being expended on collecting data, formatting, and preparing local reports. The squadron visited in preparing this thesis was producing such reports both manually and on a personal computer. While a few examples of such local reports were given earlier in this chapter, it must be remembered that valuable man-hours were spent putting these and other reports together. Management considered these reports so beneficial that they were willing to assign personnel in Maintenance Administration and Quality Assurance to enter data on a squadron owned microcomputer on a daily basis. NALCOMIS/OMA should be designed to save the man-hours currently wasted on this additional data handling.

Secondly, by entering information from, for instance, a stack of VIDS/MAFS to a microcomputer, there is a chance that typing errors will occur. Any incorrect information that ends up on a local report has the potential of causing an incorrect decision to

be made. In addition, extra time would need to be spent in correcting the error, if it's found. Productivity at every level within the squadron, therefore, may be adversely affected.

Providing the capability to create custom reports would also prove valuable to those squadrons which, upon changing Commanding Officer or Maintenance Officer, find themselves producing new daily reports. Each report that is generated manually requires at least one person to retrieve, produce, and distribute the report. Any time savings in this area can be applied to more meaningful tasks.

Providing software modules which allow the generation of local reports would not have to mean that maintenance of NALCOMIS/OMA software modules would be unmanageable. NALCOMIS/OMA could, perhaps, allow the user to specify the desired fields and format for a local report. By allowing the format to be saved and named, the report could be requested as needed by the user--daily, for example.

D. SUMMARY

Top-level management acceptance is not the only determinant of a system's success--bottom-level management acceptance is equally as important [Ref. 26:p. 55]. In order to provide the managers in the OMA with the information needed to effectively make

decisions, NALCOMIS/OMA should allow its users to select and format data to be used in local reports.

Many man-hours are currently expended producing customized reports for managers within the squadron. These reports are used to make decisions and are changed when necessary in order to fit individual (or group) management styles. In addition, an intercommunication system between Maintenance Control and each work center aids the MCPO in making his decisions.

While NALCOMIS/OMA is planned to provide some predetermined local reporting capabilities, the squadron is likely to continue producing the other local reports and management tools mentioned unless the design of NALCOMIS/OMA incorporates such capabilities. By allowing squadron users to define and produce custom reports, they would be better able to effectively manage their resources.

VIII. ESTABLISHING AN EFFECTIVE INFORMATION SYSTEM FOR THE OMA

Chapter IV presented five attributes required for an effective information system [Ref. 16:p. 5]:

1) Decision-oriented reporting.
2) Effective processing of data.
3) Effective management of data.
4) Adequate flexibility.
5) A satisfying user environment.

Next, some of the problems that users have experienced (and expect to experience) with the NALCOMIS Phase II system were identified. The NAMP procedures currently used in the collection of most of the data at the OMA were discussed and some of the potential benefits that a computerized, on-line system has to offer were identified. Then, the importance of local procedures and reporting to bottom-level user acceptance of NALCOMIS/OMA was discussed.

Now it will be shown how these problems and procedures relate to each of the five attributes mentioned above. By doing so, the importance of providing the OMA with local, pertinent, and flexible reporting capabilities will be established. Each attribute will be discussed in general and the research findings applied. In the final chapter, additional

recommendations for providing managers with useful low-level reporting capabilities will be made.

As stated earlier, NALCOMIS should "make a major impact on a key area associated with the success of the business." [Ref. 16:p. 98] Since the OMA is in business to provide mission capable aircraft, NALCOMIS should provide its greatest benefits in this area. Therefore, it will be shown how the objectives of NALCOMIS/OMA can be effective and, in so doing, provide maximum benefits to the OMA.

A. DECISION-ORIENTED REPORTING

Decision-oriented reporting means that "output from the system is designed to facilitate decision making by those persons who receive the output." [Ref. 16:p. 5] NALCOMIS/OMA should provide the maintenance manager with reports which are well-suited to aid in his decision making processes. These reports should be flexible enough to meet the changing needs of the OMA and the maintenance manager. They should also provide the correct amount of information necessary to quickly and effectively make specific decisions.

1. Tailoring Information to the Decision Maker

Nichols [Ref. 28:p. 73] states that

> The information that is generated and made available within the organization should be tailored to the task at hand...The emphasis is upon supplying each decision point with enough information, of the right quality, when it is needed.

But Nichols warns that the information necessary for decision making does not remain constant. He says that the information supplied at the decision point ideally should be changed "when changes [occur] in the capabilities of the decision-maker, or in the information made available or pertinent to the decision, or if the manager responsible for a given decision [is] changed."

The previous chapter identified some of the ways in which one OMA uses local, customized reports to satisfy the needs of its decision makers. Although several objections to having NALCOMIS/OMA provide such customized reporting were listed, the importance of getting the right information to the right person cannot be overemphasized. It is important to satisfy the user-manager in the OMA, but it is also necessary to ensure that better decision making takes place.

If NALCOMIS/OMA does not provide the maintenance manager with the information that he needs, he will obtain that, or substitute information from some other source. If NALCOMIS/OMA doesn't provide the type of local reports currently prepared by naval aviation squadrons, then the squadrons will continue to prepare them manually or continue using other, locally developed computer systems. So, the importance of such local reports has been established. Although no time

study was done to estimate man-hours spent preparing these local reports, the amount is clearly significant.

2. Satisfying Changing Needs

It is highly desirable (from the standpoint of the OMA) that NALCOMIS/OMA provide some custom reporting capabilities. In addition, the OMA should also be able to change the content and format of these reports relatively easily. Maintenance managers constantly transfer in and out of the OMA. These same managers also routinely and periodically change jobs within the organization. When a new manager, with a decision making style different from that of his predecessor, takes over a position, he often needs different information than that which has previously been provided.

It is also important to be able to manipulate data in order to "convert data into potential information relevant to the present and the future." [Ref. 28:p. 74] Since NALCOMIS/OMA (as currently planned) will not allow maintenance managers to create custom reports or allow users to download and store private data bases, such manipulation will have to occur external to NALCOMIS. Again, if the user perceives a need for information which NALCOMIS is not providing, he will obtain that information by other means--and he may question the usefulness of NALCOMIS.

3. Providing the Correct Amount of Information

"Existing computer-based systems often provide too much data; users frequently have felt overloaded with information that could not possibly be analyzed." [Ref. 21:p. 77] In order for NALCOMIS output to prove useful to managers, reports and screen output must be free of information that is not pertinent or which distracts from other, more relevant information.

4. An Example of Decision-Oriented Reporting

The Maintenance Control Passdown Log, discussed in the previous chapter, can be used to illustrate the importance of providing the right amount of information. The log provides the MCPO with the information he needs to obtain an overall view of the current maintenance situation. However, nearly all of the information contained in the log may be found by looking at the VIDS board. Although the MCPO is able to obtain some information more quickly through verbal communication with the work centers (i.e. the intercom system), he depends mostly on information contained on the VIDS board.

Why, then, does the MCPO feel that it is necessary to duplicate information from the VIDS board to the log? There are several possible reasons.

First, the log can provide a more recent snapshot of the maintenance situation than the VIDS

board provides. For example, there is a lag between the time that a MAF is completed in the work center and the time that it is received in Maintenance Control. But, because the MCPO is in verbal contact with the work center, he can make an entry in the log which reflects the fact that the job has been completed (noting, of course, that the job is not actually finished until all of the paperwork is completed).

Secondly, and most pertinent to this discussion, the log contains the amount of information that the MCPO needs to prioritize jobs and make other daily decisions. The VIDS board, while designed to provide managers with a visual representation of the overall maintenance situation, contains more information than is needed at times.

By extracting from the VIDS board a list of the discrepancies which place each of the aircraft in a partial mission capable or not mission capable status, and writing that information in the log, the MCPO can eliminate any information that he uses less frequently or not at all in his daily decision making. For example, the MCPO can write a short, plain English description (typically one or two key words) of each discrepancy. He can then use different colored ink markers to distinguish between partial and not mission capable discrepancies, completed repairs which are

awaiting paperwork, etc. The MCPO can create a management tool that contains the information that he needs to make most of his decisions. He no longer needs to walk to the VIDS board, lift up the VIDS board pockets, and read the full description of the discrepancies against an aircraft in order to determine the status of that aircraft. He can simply glance at the log, see the list of color coded aircraft discrepancies in plain English, and quickly become familiar with the current maintenance situation and any priorities that have been set.

The Maintenance Control Passdown Log is also a more flexible tool than the VIDS board. As the MCPO's information changes, the log can be updated. If aircraft, equipment, or requirements for maintenance change, the log can quickly and easily be changed as well. (More will be said concerning flexibility later in this chapter.)

Finally, the log provides information which is tailored to the needs of the manager. If a new Chief Petty Officer takes over the job of MCPO, he can immediately tailor the log so that it contains that information which he needs. For example, a new MCPO may need to list the work center codes alongside (or above) the discription of the discrepancies in the log. A more experienced MCPO, on the other hand, may know

which work centers are responsible for making specific repairs and may not need to record the work center information. The log, in effect, can be changed to fit the style and information needs of the individual decision maker.

5. Other Concerns

Other concerns, discovered during the interviews with users of the NALCOMIS Phase II system, are worth mentioning here. Chapter V said that users were concerned that: 1) NALCOMIS/OMA might be expected by users to do more for the OMA than it is designed to do and 2) NALCOMIS, in the opinion of some Phase II users, does not provide much management support.

By providing decision-oriented reporting, NALCOMIS would likely satisfy (or partially satisfy) both concerns. NALCOMIS/OMA, by putting the right information in the hands of the users, would be providing more management support than is currently planned. Also, those using the information would quickly come to learn what NALCOMIS can and cannot do for them. If customized reports could be generated by NALCOMIS, managers might even benefit in ways that have not been anticipated by those developing the system. In effect, the very scope of NALCOMIS could be broadened by the users themselves.

B. EFFECTIVE PROCESSING OF DATA

The next desirable attribute of an information system, effective processing of data, means that the "checks and controls on input and output are appropriate, system timing is meaningful in the context of the application, and the utilization of the hardware and software environment is efficient." [Ref. 16:p. 5] NALCOMIS/OMA should allow for quick and easy user access, automatically verify data as it enters the system, and process data more quickly and accurately than current manual methods. Further, NALCOMIS/OMA may collect or process data into information in ways which aren't possible with manual methods.

1. User Access to NALCOMIS

In order for NALCOMIS to improve decision making and productivity at the OMA, the system must allow for quick and easy user access. While on-line features will supposedly provide fast response to user needs, there are other considerations. As discussed in Chapter V, some users of the Phase II system were concerned that, in a hectic operational setting, NALCOMIS might prove to be slower than the current manual system.

One major concern is that, with only one NALCOMIS terminal available in each work center, only one user in each work center will be able to access

NALCOMIS at any one time. The only alternative available to a user waiting to access a work center terminal, other than to continue waiting, is to try and locate an available terminal in a different work center.

Another concern is that some terminals may not be used as much as others. Plans call for one terminal per work center. This somewhat arbitrary placement of terminals could prove to be suboptimal. For example, one terminal may not be enough to handle the amount of use in the avionics work center, while a terminal in another work center, like ordnance, stands idle a large percentage of the time.

2. Speed and Accuracy of Processing

When NALCOMIS/OMA is installed and running, will it prove to be faster and more accurate than current manual methods? If top management is to expect that NALCOMIS will contribute toward better decision making and higher productivity (and, thus, improved mission capability), then it must be faster and more accurate than the present manual system.

NALCOMIS, as a computerized system, will process information much faster once that information is entered at work center terminals. But, in order to make a useful comparison of computerized and manual systems, the time required for processing data must be

looked at in its entirety. Processing must be considered to start as users begin to log onto the system and it must be considered to end when users complete their tasks (or receive output from the system).

Users identified three potential problems which could negatively impact the speed, and therefore usefulness, of NALCOMIS/OMA (see Chapter V).

1) Each user must go through sign-on procedures to gain access to the system. In some instances, the paper VIDS/MAF system currently in use is faster in this respect. Under the present system, the VIDS/MAF may be accessed by simply retrieving the MAF from the VIDS board, making a pen entry, and replacing the MAF.

2) If two or more users in a work center need access to the system at the same time, all but one user must either wait or search for an available terminal in another work center. The VIDS board, on the other hand, allows multiple users to access different MAFs simultaneously.

3) NALCOMIS may not present data in an optimal manner. Users noted that the maintenance Chief Petty Officer, for example, may need to go through four or five different computer conversations in order to get enough information to make a simple decision. The same decision would generally be made faster by obtaining information contained in a locally maintained Maintenance Control Passdown Log.

C. EFFECTIVE MANAGEMENT OF DATA

NALCOMIS/OMA should provide for the effective management of data. Attention should be paid to "the accuracy of input data,...the maintenance of integrity once data are stored within the system [and] the

security requirements while the data are being used and on disposal." [Ref 16:p. 5]

1. Automatic Verification of Data

After tracing the flow of the VIDS/MAF within the OMA, several advantages of having a computerized, on-line VIDS/MAF system were identified (see Chapter VI). One of these advantages, automatic verification of data, could potentially save many man-hours that are currently spent manually verifying data for correctness.

The work center supervisor, Logs and Records clerk, and Quality Assurance analyst spend much of their time ensuring that information entered on the VIDS/MAF is correct. In addition, maintenance control and work center personnel must constantly ensure that their VIDS boards (and the aircraft discrepancy book) all contain the same information.

It was also noted that whenever a VIDS/MAF error was detected, someone (i.e., the VIDS board clerk) would have to take the time to trace the source of the error and make the correction. By checking information as it is entered at the keyboard, NALCOMIS/OMA will therefore, reduce such occurrences.

As Lucas [Ref. 21:p. 345] states:

> A well-designed system handles [input] errors; that is, it corrects them or notifies someone of the errors and continues producing valid output. It is not unusual to find more than half the instructions

in a program devoted to error detection and handling, especially in an on-line system.

Notice that Lucas emphasizes the importance of handling input errors in on-line systems by showing the large portion of programming devoted to handling these errors.

2. Security

In previous chapters, user identification and access to NALCOMIS/OMA was discussed. The Phase II users were concerned chiefly that, for the sake of convenience, lists of passwords might be freely passed among NALCOMIS users.

If passwords are freely exchanged among squadron personnel, then there is a chance that users will access conversations which they are not authorized to use. In addition, concern was expressed that, if responsibilities for maintenance actions needed to be traced (i.e., after an aircraft mishap), users might be able to claim that their password, and thus NALCOMIS, had been compromised.

If adequate security controls are not built into NALCOMIS/OMA from the beginning, attempts to add controls later will be very expensive and could prove to be unsuccessful [Ref. 16:p. 94]. Therefore, NALCOMIS/OMA developers should be aware of the problems which have been identified and take action to correct them.

Many state-of-the-art system access technologies (such as devices which recognize voice, retinal, or fingerprint patterns) offer promising solutions to security problems but are not part of the current plans for NALCOMIS/OMA. However, such technologies should be considered in long-range plans for changes or updates to NALCOMIS/OMA.

Until more sophisticated technologies can be feasibly incorporated into NALCOMIS/OMA, developers should force randomly generated passwords upon the users. Also, the NAMP should provide clear guidance on the use of passwords. The establishment of password lists should be forbidden by the NAMP and supported by other Navy instructions and inspection procedures should be established which will ensure that squadrons are complying with these regulations.

D. ADEQUATE FLEXIBILITY

A system which contains adequate flexibility should be able to "adapt to changes in the behavioural characteristics of those persons associated with it." [Ref. 16:p. 5] The steady turnover in squadron personnel means that decision making techniques and other personal management characteristics within the OMA will be constantly changing with time.

Flexibility, as we have already pointed out, is important in achieving user satisfaction with an

information system. Designing flexibility into a system can also prolong its useful life, thus reducing the long-run cost of the system [Ref. 16:p. 92]. So, a flexible system is not only preferred by the user, it is also beneficial to the organization as a whole.

As managers learn to use NALCOMIS, they will likely discover ways in which the system can help them improve their decision making--ways which may not have been perceived by system designers. NALCOMIS should provide flexible services so that managers may take advantage of such opportunities.

E. SATISFYING USER ENVIRONMENT

A system is said to provide a satisfying user environment if the "machine-people interfaces are appropriate for the tasks involved." [Ref. 16:p. 5] Users must find the system easy to use and it must be perceived by them as providing useful information and services.

The interface between NALCOMIS and users must be simple and easy to use from the user's standpoint. These NALCOMIS interfaces generally take the form of either terminal procedures, screens, or reports. The term interface, then, describes that part of the system which the user sees.

The user is important in determining how effective (and ultimately, how successful) NALCOMIS/OMA will be.

This is particularly true since NALCOMIS is an on-line system. As Brookes [Ref. 16:p. 269] says:

> Behavioural factors relating to operator satisfaction with the interface design and overall system logic are more important in an on-line system than in a batch system due to the close interaction and direct penetration of the on-line system into the workplace.

User satisfaction will depend on how well NALCOMIS can meet the informational needs of decision makers--decision makers who solve problems in different ways. NALCOMIS must also present this information in a format which appears logical to the user. Therefore, NALCOMIS developers must conduct further research at the OMA to determine how NALCOMIS/OMA can present the information in such a way that it suits the decision maker. Local and informal procedures in use under the current manual system, such as those discussed in this thesis, must be considered when development of NALCOMIS/OMA continues.

As revealed in Chapter V, some Phase II users felt that NALCOMIS was, in some regards, difficult to use. Some users found that learning to use the system was difficult. Also, some expressed dissatisfaction with having to go through numerous menu screens in order to accomplish certain tasks. Paper printouts were being used by some because they are faster and easier to use than the NALCOMIS screens.

Many lessons on ease of use can be learned from the Phase II system. Phase II system problems in this and

other areas should be thoroughly documented and, when development of Phase III is resumed, solutions to these problems should be included in NALCOMIS/OMA. Recommendations for screen and conversation redesign, for example, should be a top priority for NALCOMIS developers so that users will be able to process information in a shorter average time than is required to process the current paper MAF.

The fact that the current paper system (i.e., VIDS/MAF) might prove to be faster than NALCOMIS caused some concern in Phase II users who were interviewed for this thesis. For the OMA user, a faster system might be perceived as a system which is easier to use. This perception could lead to a reduction in the level of user satisfaction. If users become dissatisfied with the performance of NALCOMIS, they could choose, in certain instances, to ignore the system.

Those involved with developing NALCOMIS/OMA should reexamine the currently planned hardware topology for NALCOMIS/OMA. Time studies should be conducted at the OMA to determine the frequency with which workers require access to VIDS information in each work center. These studies are necessary to determine whether one NALCOMIS terminal per work center will be enough to handle the number of workers requiring access to NALCOMIS/OMA during peak work loads.

F. SUMMARY

There are five attributes of an effective information system [Ref. 16:p. 5]:

1) Decision-oriented reporting.
2) Effective processing of data.
3) Effective management of data.
4) Adequate flexibility.
5) A satisfying user environment.

In this chapter, the research findings discussed in previous chapters were applied to these attributes in order to show the importance of providing better local reporting capabilities in NALCOMIS/OMA.

NALCOMIS, in order to significantly improve mission capability, must provide the information necessary to improve managerial decision making and allow users to quickly and easily use the system. Managers must receive the information they need, when they need it, in order to make decisions quickly and effectively. Workers must find NALCOMIS easy to access and use, so that they will be able to spend time working on aircraft and not performing administrative tasks.

IX. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. Improving Mission Capability

The Organizational Maintenance Activity is in business to provide mission capable aircraft. If it is to help significantly improve mission capability at the OMA, NALCOMIS/OMA must provide improvements in two key areas: decision making and worker productivity.

a. Decision Making

NALCOMIS/OMA, as currently planned, will support decision making at the OMA through the use of predefined reports and on-line screens. The reports that will be generated by NALCOMIS are primarily summarized reports to be sent to higher levels of management. As one moves down the management chain of command in the OMA, however, the need for information generally changes to that which is more detailed and real-time in nature. As more and more detail is required by these managers, it will become more likely that pre-defined reports will not satisfy their information needs.

Providing maintenance managers with the capability of creating local, customized reports would require that the developers change their present plan

for NALCOMIS/OMA. The ability to create custom reports would ensure that local squadron decision makers receive the information they need, when they need it--thus helping to improve mission capability.

b. Worker Productivity

Worker productivity also influences mission capability rates. In order for productivity to increase, workers must be freed from non-essential tasks so that they are able to spend as much of their time as possible directly on aircraft repairs. NALCOMIS/OMA, therefore, must provide users with fast and easy access to NALCOMIS functions, allow for fast and accurate data entry, and check these entries for validity. NALCOMIS must provide these services in a way which is better than the current manual system or significant improvements in mission capability are unlikely to occur as a result.

The computerized, on-line VIDS/MAF provided for by NALCOMIS/OMA can help improve worker productivity by offering several advantages over the current manual system:

1) Less lost paperwork.

2) Elimination of the physical delivery of VIDS/MAF copies.

3) Fewer data entry errors.

4) Automatic verification of data.

5) Less handling of data.

2. Lessons Learned From Phase II

Numerous problems encountered by users of NALCOMIS Phase II should be resolved prior to further NALCOMIS/OMA development:

a. Users' Expectations

Users must have a thorough understanding of NAMP procedures and the NALCOMIS functions with which they will be dealing in order to prevent overly high expectations on the part of the users. An understanding of the NAMP and current manual procedures is also necessary in the event that NALCOMIS breaks down and users must revert to a manual (paper VIDS/MAF) back-up system.

b. Ease of Use

Although screens and conversations have been designed with ease of use in mind, learning to use NALCOMIS may present a problem for new users. Even after gaining experience with NALCOMIS/OMA, some users may continue using paper forms in lieu of some NALCOMIS menus and screens.

c. The Automated VIDS/MAF

In some cases NALCOMIS will require more effort than the current manual system. With an automated MAF, it is necessary to take a certain amount of time to log onto the system and go through the appropriate conversations. Each user must perform

these logon procedures prior to using NALCOMIS, even for very simple tasks. A queuing problem can potentially develop any time more than one user within the work center needs access to the system at the same time.

It may be more difficult to understand the overall maintenance situation from NALCOMIS screen outputs than is currently done with the VIDS board. Maintenance managers may feel much less confidence in their abilities without the presence of a VIDS board in maintenance control.

More personnel may be required in Maintenance Control under NALCOMIS/OMA than with the current manual system. Besides the extra effort required to see the overall maintenance picture, one terminal within Maintenance Control may prove to be inadequate. Since the maintenance effort is so dependent on the VIDS board for decision making, as many as three terminals might be required to allow Maintenance Control to keep up with all of the information necessary to coordinate the maintenance effort.

d. Ignoring the System

On occasion, some personnel may attempt to bypass, or intentionally ignore, NALCOMIS. Heavy schedule pressures, compounded by the fact that NALCOMIS may, under some circumstances, be slow or

momentarily inaccessible, could mean that simple discrepancies will not be written up at all. If NALCOMIS is judged by users as being slower or more trouble than the current paper system and, as a result, is ignored by maintenance personnel, safety may be jeopardized.

e. Security

User passwords could freely be handed from one person to another for the sake of convenience. Lists of passwords (e.g., a work center supervisor in possession of the passwords of Collateral Duty Inspectors and Quality Assurance Representatives) could be used in order to quickly and conveniently sign off a MAF. Such practices could make it very difficult to prove or disprove claims by an individual that his password has been compromised.

f. Purging of Data

Retrieving data that has already been purged from the squadron's NALCOMIS data base may be a very time-consuming process. Those needing to keep information for historical purposes, such as Quality Assurance, will probably keep printouts and continue using manual information storage and retrieval methods.

g. Management Support

NALCOMIS/OMA may not readily provide managers with the information needed to make day-to-day

decisions. NALCOMIS/OMA could be streamlined in some functional areas in order to make room for more management information.

The concepts which are encompassed in current plans for NALCOMIS/OMA are seen by present and potential future users as being both necessary and highly desirable. Automation and the resulting changes in current procedures are viewed as worth the effort. NALCOMIS Phase II users and squadron maintenance managers who were interviewed for this thesis felt that an automated maintenance system is long overdue. There is no reason to expect that NALCOMIS/OMA cannot be successfully introduced to the fleet once these and other critical management issues are adequately resolved.

B. RECOMMENDATIONS

Based on the research conducted in the course of this thesis, the following recommendations for improvements to NALCOMIS/OMA and the need for further research are proposed:

1. Streamlining NALCOMIS/OMA

The functions of NALCOMIS/OMA should be limited to those which will contribute toward improved mission capability. First, NALCOMIS/OMA should provide better support to local decision makers by allowing the creation of customized reports and screens. Also,

special emphasis should be placed on ensuring the successful implementation of the interface with the Supply Support Center. Secondly, NALCOMIS/OMA should reduce the time that workers spend on non-essential tasks. The time required for users to access NALCOMIS/OMA should be minimized. An attempt should also be made to reduce the number of screens and conversations required to obtain routine information.

2. Reporting Up the Chain of Command

Consideration should be given to allowing squadron Maintenance Officers the option of screening, and subsequently editing information being reported up the chain of command. As discussed in Chapter III, automatic reporting of data could result in several undesirable conditions.

3. Low-Level User Involvement

Further development of NALCOMIS/OMA should include more low-level user involvement. Without the acceptance of low-level management, NALCOMIS won't be likely to achieve the degree of success that top management intends.

4. Learning From Phase II

Comprehensive documentation of NALCOMIS Phase II development, testing, and user problems should be kept and applied to further NALCOMIS/OMA development to ensure that common problems are dealt with in a timely

fashion. While some parallel development of Phases II and III has taken place, lessons learned from Phase II should be promptly applied to NALCOMIS/OMA.

5. OMA-IMA Functional Relationship

Further study should be conducted to determine which functions of NALCOMIS Phase II are appropriate for the OMA. While many of the functions of Phase II appear to be suitable for implementation at the OMA, certain environmental differences exist between the IMA and the OMA. For example, schedule pressures and operational commitments at the OMA create considerably different requirements for information.

6. Local, Informal OMA Functions

Further study of local, informal OMA functions and processes should be conducted in order to assess their potential impacts on NALCOMIS/OMA. For example, the intercom system used by squadron maintenance departments provides maintenance managers with fast, real-time information. If the intercom system provides information faster than some portion of NALCOMIS/OMA, then maintenance personnel will continue to use the intercom instead of that portion of NALCOMIS.

APPENDIX A: ACRONYMS

ADB - Aircraft Discrepancy Book

ADP - Automated Data Processing

AIMD - Aircraft Intermediate Maintenance Department

AMO - Assistant Maintenance Officer

AV-3M - Aviation Maintenance and Material Management System

AWM - Awaiting Maintenance

AWP - Awaiting Parts

CDI - Collateral Duty Inspector

COBOL - Common Business Oriented Language

CPO - Chief Petty Officer

CPS - Characters Per Second

DOD - Department of Defense

DPS - Distributed Processing System

DSF - Data Services Facility

HIS - Honeywell Information System

IMA - Intermediate Maintenance Activity

IMRL - Individual Material Readiness List

JCN - Job Control Number

LAMPS - Light Airborne Multi-Purpose Systems

LPM - Lines Per Minute

MAF - Maintenance Action Form

MAG - Marine Corps Aircraft Group

MB - Megabyte

MCAS - Marine Corps Air Station

MCPO - Master Chief Petty Officer

MDR - Maintenance Data Report

MIS - Management Information System

MMCO - Maintenance/Material Control Officer

MMP - Monthly Maintenance Plan

MW - Megaword

NALCOMIS - Naval Aviation Logistics Command Management Information System

NALCOMIS/OMA - Naval Aviation Logistics Command Management Information System for Organizational Maintenance Activities

NAMP - Naval Aviation Maintenance Program

NAVMASSO - Navy Management Systems Support Office

NDS - NALCOMIS for Detachments Subsystem

NMCS - Not Mission Capable Supply

NRMM - NALCOMIS Repairables Management Module

OMA - Organizational Maintenance Activity

OPTAR - Operating Target

PMA - Project Manager Air

PMCS - Partial Mission Capable Supply

QA - Quality Assurance

QA/A - Quality Assurance/Analysis

QAR - Quality Assurance Representative

SMQ - Special Maintenance Qualification

SNAP - Shipboard Non-Tactical ADP Program

SSC - Supply Support Center

VERTREP - Vertical Replenishment

VIDS - Visual Information Display System

VIDS/MAF - Visual Information Display System/Maintenance Action Form

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